final report

Murphy Creek Hydroelectric Project

Vegetation Studies

for

B. C. Hydro & Power Authority

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This impact assessment is based on the "Murphy Creek Project Engineering Description" prepared in November 1982. Since that time, ongoing planning and design studies have resulted in some changes that would affect the project description. The principal changes are as follows:

- In-service date has changed from 1993 to 1995.

- Installed capacity has changed from 300 MW to 275 MW.

- Small changes to the design and locations of shoreline protective works.

- Daily reservoir level fluctuations limited to 2.0 m during March, April and May (previously March and April).

The above changes have been incorporated in the report only where they would affect the results of the impact assessment.

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SUMMARY: VEGETATION STUDIES

STUDY AREA VEGETATION

Although the study area is within the Interior Western Hemlock Biogeoclimatic Zone, western hemlock is not a dominant tree species. Logging, land clearing for agriculture and settlement, wildfires and emissions of sulphur dioxide (SO_2) prior to the installation of pollution control devices at the Cominco Smelter in Trail have greatly altered the climax forest vegetation which once covered the lower slopes and terraces of the study area.

A diverse mixed wood forest, generally 40 to 75 years old, has developed in response to these disturbances. Presently, white birch, lodgepole pine, ponderosa pine, western white pine, western larch, Douglas-fir, trembling aspen, black locust, black cottonwood and a variety of shrubs, forbs and grasses occur as seral species.

In the floodplain, adjacent lowlands and fan margins, several lowland vegetation types are developed on the alluvial gravels, sands and silts where a high water table exists. These types are open to moderately dense deciduous, or mixed forest-shrub, or shrub communities. Typical species found on undisturbed

sites include black cottonwood, willows, white birch, Saskatoon berry, mock orange, western red cedar and western yew.

Areas characterized by shallow, coarse textured soils occurring in pockets over bedrock typically support open canopy forest communities composed predominantly of Douglas-fir, ponderosa pine, lodgepole pine and various shrubs including redstem ceanothus, lupines, bearberry and grasses. These areas occur sporadically throughout the study area, usually at elevations greater than 450 m a.s.l.

Cleared and abandoned or other disturbed sites, usually associated with historical agricultural use, are common in the study area. Soils are usually coarse textured and often have a high percentage of coarse fragments. The soils are derived from fluvial and glaciofluvial terraces and fans. Ground cover is usually dominated by domestic grasses and weeds such as yarrow, knapweed and thistles. Decadent fruit trees (apple, pear, cherry and plum) are found, but seldom produce much fruit.

The remaining lower valley slopes and benches are covered with coarse textured glaciofluvial or colluvial deposits possessing a high percentage of coarse fragments ranging from gravels to large boulders. These areas support dense to moderately dense mixed forests dominated by western larch, ponderosa pine, lodgepole pine and white birch. Shrubs and herbs are often few in denser forests, but redstem ceanothus, false box, spreading dogbane and waxberry commonly occur in more open stands.

Table S.1 summarizes the characteristic plant species in each of the broad vegetation types encountered in the study area.

TABLE S.1

SUMMARY OF DISTRIBUTION OF PLANT SPECIES
IN DOMINANT VEGETATION TYPES

	FLOODPLAIN AND LOWLANDS	ROCKY OUTCROPS	ABANDONED AND/OR DISTURBED LAND	LOWER SLOPES AND BENCHES
TREES:				
Black cottonwood	2			+
White birch	+	+	+	2
Douglas maple	1			+
Black hawthorn	+			
Aspen	+	+	+	+
White pine		1		1
Ponderosa pine		1		1
Lodgepole pine		1		1
Western red cedar	1			+
Western larch				1
Western hemlock				+
Douglas-fir	+	+		1
Grand fir				+
Rocky Mtn juniper	+			
Western yew	+			+
SHRUBS:				
Thimbleberry	1	1	1	
Redstem ceanothus	1	+		1
Ocean spray		1		+
Saskatoon berry	1	2		+
Hazelnut	1	1	1	1-2
Red elderberry	+			+
Black blueberry	+			+
Waxberry	1	+		1
Mahonia	1	+		1
Spreading dogbane	1	+	+	1
HERBS & LOW SHRUBS:				
Grasses	+	2	2	+
Twinflower				1
Bearberry	1	1	+	+
Poison ivy		1	+	
Queen's cup	1			1
Rattlesnake plantain	1			1
Star-flowered Solomon's seal	1			+
Knapweed			2	
Bluebell	1			+
Lupine		+		1
Sarsaparilla	+			

KEY: 1 denotes <25% cover
2 denotes 25-75% cover
3 denotes >75% cover
+ denotes species present, undetermined cover

SUMMARY: VEGETATION STUDIES

POSSIBLE PROJECT IMPACTS ON VEGETATION

A summary of the direct losses of vegetation at the proposed reservoir level of EL 424 m is presented in Table S.2, together with comparative losses at the two higher reservoir levels initially assessed in the environmental studies. This table indicates that approximately 217 ha of lowland vegetation would require clearing for the reservoir at the proposed 424 m reservoir level. The total would increase to 364 ha if a water level of 427 m is considered, and at the highest water level studied, EL 430 m, a total of 480 ha of natural vegetation would be lost from the study area's lowland vegetation resource base.

These estimates do not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance. The areas of disclimax plant communities contain no significant areas of tall woody species that would require clearing prior to reservoir filling.

Table S.3 summarizes direct vegetation impacts related to possible damsite construction. Based on the preliminary conceptual design information provided, a total of approximately 96 ha of natural vegetation would be occupied by cut, fill, spillway, powerhouse works, till site, access road, spoil areas, construction camp and work areas, as well as associated highway, railway and transmission line relocation. As with the estimates of inundation impacts, these estimates do not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance. Since reclamation of almost all of these areas is possible these impacts are considered temporary.

Table S.2

SUMMARY OF DIRECT VEGETATION IMPACTS AT THREE PROPOSED RESERVOIR WATER LEVELS BY SUB-AREA[a,b]

SUB-AREA		AREA, IN HECTARES, OF VEGETATION INUNDATED FROM:		
		RIVER BANK TO EL 424 m	424 TO 427 m	427 TO 430 m
1	Columbia River North Shore	4	3	8
2	Columbia River South Shore	4	3	2
3	Pass Creek	24	70	5
4	Kootenay River	6	8	30
5	Castlegar-Kinnaird	31	15	15
6	Castlegar Airport	13	4	18
7	Champion and Jordan Creeks	19	16	9
8	Blueberry Creek - Genelle	29	16	16
9	Billy Creek	37	7	8
10	Oasis	50	5	5
	SUBTOTAL	217	147	116
	CUMULATIVE TOTAL	217	364	480

[a]Does not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance.

[b]EL 427 m and EL 430 m are no longer being considered but are presented to illustrate comparative losses at the three reservoir operating levels initially assessed in the environmental studies.

Table S.3

SUMMARY OF DIRECT VEGETATION IMPACTS
RELATED TO DAMSITE CONSTRUCTION

SUB-AREA		AREA, IN HECTARES, OF VEGETATION[a] OCCUPIED BY WORKS[b]
9	BILLY CREEK	50
10	OASIS (including the Murphy Creek Till Site)	46
	TOTAL	96

[a]Does not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance.

[b]Includes cut and fill areas along proposed dam axis, spillway and powerhouse works, till site, till site access road, spoil areas, construction camp and work areas, and relocation of highway and railway rights-of-way required for dam construction.

SUMMARY: VEGETATION STUDIES

None of these potentially impacted areas of vegetation are in Ecological Reserves or in areas for which application for reserve status has been made or is pending.

In addition, as much as 164 ha to 264 ha of vegetation is within an assumed worst case erosion hazard zone and may be subject to long term disturbance over the life of the project. Of this area as much as 24 ha to 48 ha may be permanently lost over the assumed 70 year life of the project, while the remaining area represents lands which may incur temporary impacts. It is stressed that these estimates are highly speculative and are based on a worst case scenario.

In summary, direct and indirect impacts on vegetation are expected to be most widespread and significant at the lowest portions of alluvial fans, at the confluences and valleys of creeks which flow into the Columbia River, at the till extraction site and on steep vegetated banks above the reservoir where no shoreline protection is proposed. Impacts on vegetation are expected to be highest at the following locations:

* Pass Creek valley and alluvial fan (Sub-Area 3)
* Kootenay River and Selkirk College lowlands (Sub-Area 4)
* Champion Creek valley and alluvial fan (Sub-Area 7)
* Blueberry Creek - China Creek valleys and fans (Sub-Area 8)
* Jordan Creek to Billy Creek lowlands (Sub-Area 9)
* Oasis damsite and Murphy Creek till extraction site (Sub-Area 10)
* Vegetated steep bank areas where no shoreline protection is proposed

SUMMARY: VEGETATION STUDIES

REGIONAL IMPACTS

Impacts of the proposed Murphy Creek dam and reservoir would be evident throughout the lowlands of the study area. Deciduous forests, mixed wood forests and shrubby communities which occur on the banks and lowlands along or near the Columbia River would be most affected.

It does not appear that any one vegetation type, at the level of type identification carried out in this study, would be totally eliminated from the study area at EL 424 m or the two higher reservoir levels initially considered. The only species identified that would be substantially affected by the project appears to be Rocky Mountain juniper. Most of these trees are found below the possible maximum reservoir levels considered in this study and would be lost if the project proceeds. However, sporadic showings of this species in upland areas not subject to possible flooding do occur in the study area, and certainly in a broader regional context, juniper is not considered to be a rare or unusual species.

Although most of the vegetation of the area is not in a pristine state, deciduous and mixed wood forests and shrubland vegetation types are highly visible in the study area. They provide wildlife habitat, local recreational areas and buffer strips, as well as being aeschetically pleasing. Given that much of the lowland vegetation of the study area has been significantly altered through land clearing for many uses, and that nearby lowland areas have been given up for the impoundment of water associated with other hydroelectric developments, any loss of lowland vegetation, however limited, is considered significant. However, because the Murphy Creek reservoir would have a relatively low head and because the reservoir area is already relatively highly developed and disturbed by settlement

patterns and other land uses, the impacts of the project, from a vegetation perspective, are not considered to be a major environmental concern.

MITIGATION OPPORTUNITIES

Measures available to reduce, or mitigate potential impacts on vegetation due to dam construction and reservoir clearing are limited because most of the major impacts on the vegetation resource base are considered permanent. However, some steps may be taken which will aid in the stabilization of soil to protect lowland sites, and which will speed the re-establishment of self-sustaining vegetative cover.

As far as possible, clearing and disturbance should be confined to the reservoir area and till site only, and caution should be exercised with respect to the remaining vegetation when removing slash and debris.

A detailed reclamation plan should be prepared prior to the clearing program, so that site preparation, resloping, and revegetation can be completed soon after any disturbance has taken place in areas that will not be inundated. A complete reclamation program of all borrow-pits, road cuts, and other major disturbances should be initiated as soon after clearing as is practical. This program should also address the drawdown zone of the reservoir and potential dust problems. All reclamation plans should be discussed and reviewed by the appropriate government agencies.

CHAPTER 1

INTRODUCTION

This study arose in response to a request, dated March 13, 1980, by the Generation Planning Department of B.C. Hydro for proposals to carry out the vegetation component of the detailed feasibility assessment of the proposed Murphy Creek Hydro-electric Project. In a letter of confirmation, dated April 24, 1980, Talisman Land Resource Consultants were contracted to provide these services.

Talisman personnel principally responsible for the vegetation studies and impact assessment carried out in this project were Wayne Biggs, P.Ag. and Jace Standish, R.P.F.

Paul Christie, P.Ag., functioned as project director for all the environmental studies carried out by Talisman on the Murphy Creek Project. Mr. Biggs is the principal author of this report, and Dan Schroeter, P.Ag., acted as editor.

The terms of reference for the vegetation studies (see Appendix A) require both an inventory of the vegetation resources of the study area and region, and an assessment of the short and long term impacts of the proposed project on the present and future vegetation resources of the area. The terms of reference also

call for identification of opportunities for mitigating any adverse impacts caused by the project.

The vegetation studies are an important component of the overall environmental assessment because the vegetation resources of the area are a highly visible feature of the natural landscape and because of the role of plants as the primary producers in ecosystems which support animal life. Plant communities are reliable indicators of past and present conditions since they respond to most natural or man-made changes in the environment. An understanding of the succession, community structure, use, tolerance and distribution of plants in the study area is important in assessing the impacts of the proposed project.

The study area for the vegetation studies consists of all lands below elevation (EL) 800 metres above sea level (a.s.l.) adjacent to the Columbia and Kootenay Rivers and within the limit of the available photomosaic mapping, from an area immediately downstream of the proposed damsite near Oasis, B.C., upstream on the Columbia River to the Hugh Keenleyside Dam, and upstream on the Kootenay River to the Brilliant Dam (see Figure 1.1). A portion of the Pass Creek Valley and the proposed Murphy Creek till removal site were also included in the vegetation study.

To facilitate the understanding and use of this report, the detailed study area inventory and impact assessment that follows is presented by ten sub-areas, as well as for the total study area. The sub-areas, shown in Figure 1.1, are as follows:

Sub-Area 1: Columbia River North
(Hugh Keenleyside Dam to Robson)

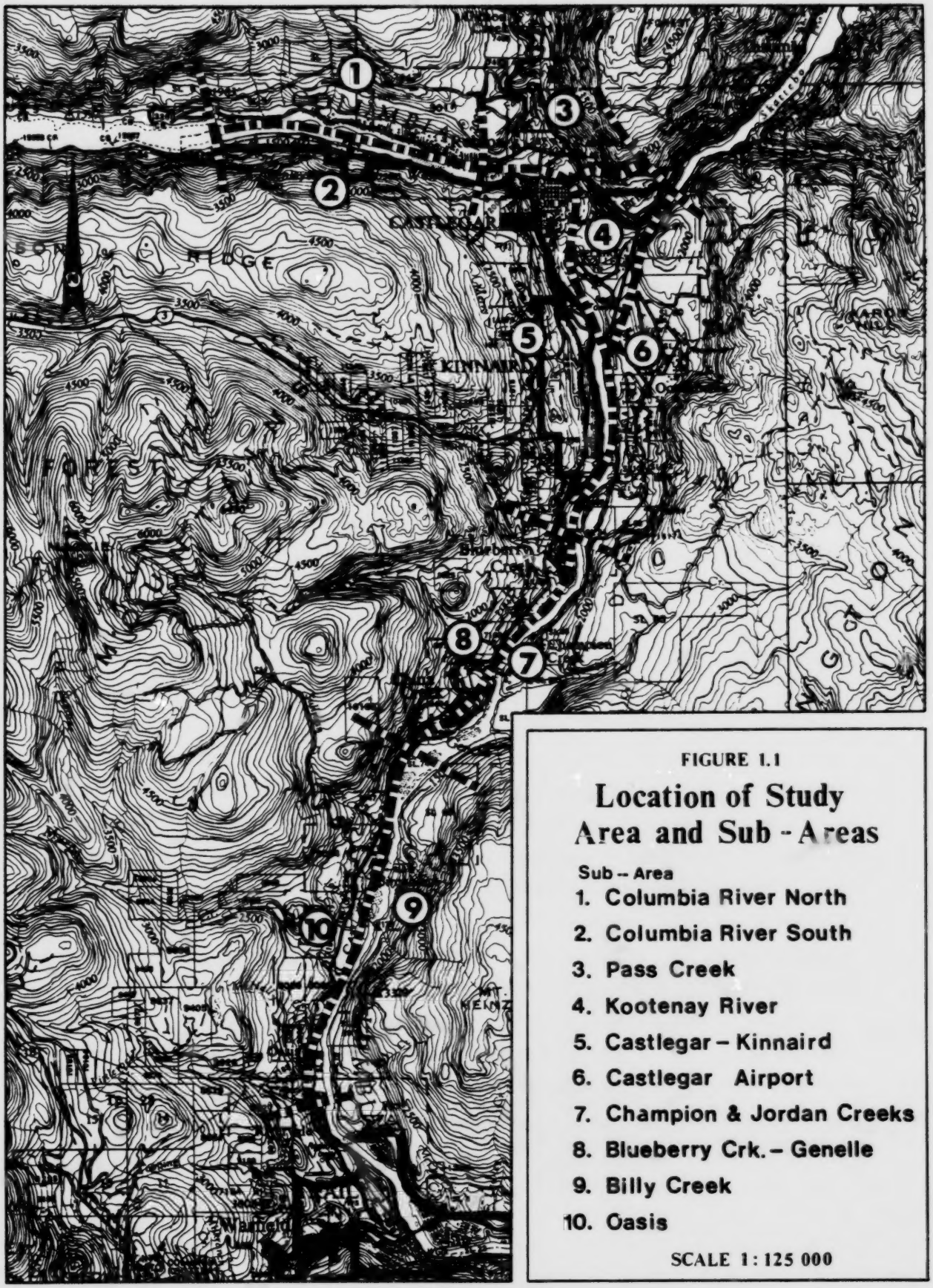


FIGURE 1.1

Location of Study Area and Sub - Areas

Sub -- Area

1. Columbia River North
2. Columbia River South
3. Pass Creek
4. Kootenay River
5. Castlegar – Kinnaird
6. Castlegar Airport
7. Champion & Jordan Creeks
8. Blueberry Crk. – Genelle
9. Billy Creek
10. Oasis

SCALE 1 : 125 000

Sub-Area 2: Columbia River South
(Hugh Keenleyside Dam to Castlegar)
Sub-Area 3: Pass Creek
Sub-Area 4: Kootenay River
Sub-Area 5: Castlegar - Kinnaird
Sub-Area 6: Castlegar Airport
Sub-Area 7: Champion and Jordan Creeks
Sub-Area 8: Blueberry Creek - Genelle
Sub-Area 9: Billy Creek
Sub-Area 10: Oasis (including the Murphy Creek till site)

The report that follows is the fifth draft of the Murphy Creek vegetation studies and supercedes all previous drafts. This draft has been revised to incorporate responses to relevant review comments by B.C. Government and B.C. Hydro reviewers. The basis on which this report was written remains the program of field work and data compilation that was carried out in the summer of 1980. The description of the present status of study area vegetation resources portrayed in the report is based on observed status as of that date.

The following report is presented in three chapters. Chapter 2 provides a background description of regional vegetation, Chapter 3 documents a detailed inventory description of study area vegetation resources, and Chapter 4 presents an assessment of the possible impacts that the proposed hydroelectric project would have on study area vegetation. A set of appendices follows Chapter 4.

The reader is also referred to the Resource Atlas for this project prepared by Thurber Consultants Ltd. It contains the vegetation mapping that was carried out in the inventory phase of these studies.

CHAPTER 2

VEGETATION RESOURCES: REGIONAL OVERVIEW

BIOGEOCLIMATIC ZONES AND FOREST REGIONS

The study area is within the Interior Western Hemlock Biogeoclimatic Zone (Krajina, 1965 and 1969)[1] and the Columbia Forest Region (Rowe, 1972). The climax vegetation consists of dense coniferous forest dominated by western hemlock (Tsuga heterophylla (Raf.) Sarg.) and western red cedar (Thuja plicata Donn). The region is one of the richest in coniferous tree species in the province. The following species occur: western hemlock, western red cedar, interior Douglas-fir (Pseudotsuga menziesii (Mirbel) Franco var. glauca (Beissn.) Franco), western larch (Larix occidentalis Nutt.), western white pine (Pinus monticola Dougl.), lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.), grand fir (Abies grandis (Dougl.) Forbes), and ponderosa pine (Pinus ponderosa Laws.). Subalpine fir (Abies lasioscarpa (Hook.) Nutt.) and Engelmann

[1]The B.C. Ministry of Forests, Research Branch, has recently modified Krajina's zonation. However, sampling and mapping in the study area has not yet commenced. The study area will be within the Interior Cedar - Hemlock Zone in the Ministry of Forests' classification.

spruce (Picea engelmannii Parry) are found to a lesser extent. Whitebark pine (Pinus albicaulis Engelm.) has a scattered occurrence at high elevations.

CLIMAX ECOSYSTEMS

Zonal (climatic climax) ecosystems are characterized by dense coniferous stands dominated by western hemlock, Douglas-fir and western white pine. Mosses, such as Pleurozium schreberi (Brid.) Mitt., and shrubs and herbs such as false box (Pachistima myrsinites (Pursh) Raf.), black blueberry (Vaccinium membranaceum Dougl.), twinflower (Linnaea borealis L.), prince's pine (Chimaphilo umbellata (L.) Bart.) and western teaberry (Gaultheria ovatifolia Gray) occur in the understory. The associated soils are Ortnic or Degraded Dystric Brunisols derived from medium to coarse textured morainal, colluvial or glaciofluvial parent materials.

Drier (edaphic climax) ecosystems are characterized by species such as lodgepole pine, ponderosa pine, Douglas-fir, western hemlock, bearberry (Arctostaphylos uva-ursi (L.) Spreng.), grouseberry (Vaccinium scoparium Leiberg), and lichens of the Cladina and Peltigera genera. On more nutrient-rich dry sites grasses such as pinegrass (Calamagrostis rubescens Buckl.), western fescue (Festuca occidentalis Hook.) and bluebunch wheatgrass (Agropyrum spicatum (Pursh) Scribn. & Smith) occur. Associated soils are Dystric and Eutric Brunisols and shallow Regosols.

Moist (edaphic climax) ecosystems are characterized by species such as Mnium mosses, devil's club (Oplopanax horridus (Smith) Miq.), oak fern (Gymnocarpium dryopteris (L.) Newm.), sarsaparilla (Aralia nudicaulis L.) and western red cedar. As-

sociated soils include Gleysols, Brunisolic Gray Luvisols and Humo-Ferric Podzols.

Mnium mosses, and western red cedar, along with skunk cabbage (Lysichitum americanum Hulten & St. John), are associated with gleysolic black muck soils occurring in poorly drained depressions.

Species such as black cottonwood (Populus balsamifera L. ssp. trichocarpa (Torrey & Gray) Brayshaw), red osier dogwood (Cornus stolonifera Michx.) and star-flowered Solomon's seal (Smilacina stellata (L.) Desf.) are associated with regosolic soils on recent alluvial sites.

PRESENT VEGETATION

Because of widespread past disturbances from wildfires, logging, land clearing and other causes, immature coniferous and mixed (coniferous-deciduous) stands along with accompanying seral understory species dominate the forest landscape over much of the region. The stands are composed of many species, including most of those previously mentioned in the discussion on natural climax vegetation. In addition, some areas have been cleared for agriculture and settlement and often bear little resemblance, either physiognomically or floristically, to the natural forest vegetation.

VEGETATION OF SPECIAL INTEREST

Noteworthy features of the regional vegetation include the diversity of coniferous tree species, resemblances to coastal vegetation, species with a limited range in the province which

occur in the region, and introduced species. The diversity of coniferous tree species in the region has already been mentioned. It is not uncommon to find six or more different tree species within a small plot area (e.g. 500 square metres) in many stands. This contrasts with many other regions in British Columbia where one or two species dominate extensive forested areas.

Many species occurring in the region are typically associated with coastal rather than interior regions. Examples include western hemlock, western red cedar, grand fir, western yew (Taxus brevifolia Nutt.), cascara (Rhamnus purshiana DC.), ocean spray (Holodicus discolor (Pursh) Maxim.) and western teaberry.

Several species occurring in the region have a somewhat limited distribution in British Columbia. Examples include grand fir, western white pine, western larch, western yew, cascara, poison ivy (Rhus radicans L.) and western teaberry. However, all of these species do occur in other regions of the province.

The only noteworthy introduced species occurring as a wild plant in the region is black locust (Robinia pseudoacacia L.). Black locust, a native tree of the east-central United States, was introduced at some undetermined time, probably as an ornamental tree and possibly also as a species used for mining reclamation. Small but pure stands have become established in many areas particularly along creeks and settlements in the vicinity of Trail, Oasis and Murphy Creek.

CHAPTER 3

STUDY AREA VEGETATION

Although the study area is within the Interior Western Hemlock Biogeoclimatic Zone (Krajina, 1965 & 1969), western hemlock is not a dominant tree species. Logging, land clearing for agriculture and settlement, wildfires, and emissions of sulphur dioxide (SO_2) prior to the installation of pollution control devices at the Cominco Smelter in Trail have greatly altered the climax forest vegetation which once covered the lower slopes and terraces of the study area.

A diverse mixed wood forest, generally 40 to 75 years old, has developed in response to these disturbances. Presently, white birch (Betula papyrifera Marsh.), lodgepole pine, ponderosa pine, western white pine, western larch, Douglas-fir, trembling aspen (Populus tremuloides Michaux), black locust, black cottonwood and a variety of shrubs, forbs and grasses occur as seral species.

STUDY AREA OVERVIEW

Before detailing the vegetation found within each of the ten sub-areas of the study area it is useful to gain a general

perspective on vegetation types occurring in the study area. Plant communities are generally associated with the various landform/terrain units encountered.

In the floodplain, adjacent lowlands and fan margins, several lowland vegetation types are developed on the alluvial gravels, sands and silts where a high water table exists.

These types are open to moderately dense deciduous, or mixed forest-shrub, or shrub communities. Their species composition and physiognomy vary considerably according to their successional stage. Typical species found on undisturbed sites include black cottonwood, willows (Salix spp.), white birch, Saskatoon berry (Amelanchier alnifolia Nutt.), mock orange (Philadelphus lewisii Pursh), western red cedar and western yew. These species are common on the islands and margins of the Columbia and Kootenay Rivers as well as in the lowlands of Pass Creek, Champion Creek, Blueberry Creek, China Creek and along smaller tributary streams.

Areas characterized by shallow, coarse textured soils occurring in pockets over bedrock typically support open-canopy forest communities composed predominantly of Douglas fir, ponderosa pine, lodgepole pine and various shrubs including redstem ceanothus (Ceanothus sanguineus Pursh), lupines (Lupinus spp.), bearberry and grasses. These areas occur sporadically throughout the study area, usually at elevations greater than 450 metres a.s.l. Type localities include the Robson and Oasis areas.

Cleared and abandoned or other disturbed sites, usually associated with historical agricultural use, are common in the study area. Soils are usually coarse textured and often have a high percentage of coarse fragments. The soils are derived from

fluvial and glaciofluvial terraces and fans. Ground cover is usually dominated by domestic grasses and weeds such as yarrow (Archillea millefolium L.), knapweed (Centaurea spp.) and thistles (Cirsium spp.). Decadent fruit trees (apple, pear, cherry and plum) are found, but seldom produce much fruit. Type localities include the Brilliant fan (Kootenay River fan), the Champion Creek fan and the terraces in the vicinity of Castlegar Airport.

The remaining lower valley slopes and benches are covered with coarse textured glaciofluvial or colluvial deposits possessing a high percentage of coarse fragments ranging from gravels to large boulders. These areas support dense to moderately dense mixed forests dominated by western larch, ponderosa pine, lodgepole pine and white birch. Shrubs and herbs are often few in denser forests, but redstem ceanothus, false box, spreading dogbane (Apocynum androsaemifolium L.) and waxberry (Symphoricarpus albus (L.) Blake) commonly occur in more open stands. This vegetation type is common throughout the study area and occurs on both sides of the Columbia River from the Hugh Keenleyside Dam to Castlegar and south along the Columbia River Valley to Oasis.

Table 3.1 summarizes the characteristic plant species in each of the broad vegetation types encountered in the study area.

The following sections provide detailed, specific descriptions of vegetation found in each of the ten defined sub-areas of the study area.

TABLE 3.1

SUMMARY OF DISTRIBUTION OF PLANT SPECIES
IN DOMINANT VEGETATION TYPES

	FLOODPLAIN AND LOWLANDS	ROCKY OUTCROPS	ABANDONED AND/OR DISTURBED LAND	LOWER SLOPES AND BENCHES
TREES:				
Black cottonwood	2			+
White birch	+	+	+	2
Douglas maple	1			+
Black hawthorn	+			
Aspen	+	+	+	+
White pine		1		1
Ponderosa pine		1		1
Lodgepole pine		1		1
Western red cedar	1			+
Western larch				1
Western hemlock				+
Douglas-fir	+	+		1
Grand fir				+
Rocky Mtn juniper	+			
Western yew	+			+
SHRUBS:				
Thimbleberry	1	1	1	
Redstem ceanothus	1	+		1
Ocean spray		1		+
Saskatoon berry	1	2		+
Hazelnut	1	1	1	1-2
Red elderberry	+			+
Black blueberry	+			+
Waxberry	1	+		1
Mahonia	1	+		1
Spreading dogbane	1	+	+	1
HERBS & LOW SHRUBS:				
Grasses	+	2	2	+
Twinflower				1
Bearberry	1	1	+	+
Poison ivy		1	+	
Queen's cup	1			1
Rattlesnake plantain	1			1
Star-flowered Solomon's seal	1			+
Knapweed			2	
Bluebell	1			+
Lupine		+		1
Sarsaparilla	+			

KEY: 1 denotes <25% cover
2 denotes 25-75% cover
3 denotes >75% cover
+ denotes species present, undetermined cover

STUDY AREA VEGETATION

SUB-AREA 1:
COLUMBIA RIVER NORTH (HUGH KEENLEYSIDE DAM TO ROBSON)

General

This sub-area is characterized by a variety of disturbed sites, and closed and open canopy mixed wood forests. Irregular topography, southern exposure, and a high diversity of vegetation types provide wildlife habitat in the sub-area.

Riparian and Lowland Vegetation

Heavily disturbed, bare and sandy sites with scattered weedy vegetation occur near the Hugh Keenleyside Dam site at the west end of the sub-area.

A fairly dense mixed wood forest of white birch, black cottonwood, willow, Douglas-fir, and pine occurs in a green-belt which runs between the river and the highway. Although this vegetation type has been cleared in places for housing, this linear treed zone is highly visible and could be important passerine bird habitat.

Recently disturbed areas along banks, roadways and ditches are dominated by knapweed, thistle, bracken fern (Pteridium aquilinum (L.) Kuhn.), great mullein (Verbascum thapsus L.), and other weedy species.

Upland Vegetation

Much of the natural upland vegetation of this sub-area has been removed, or significantly altered, by the settlement of Robson, road cuts and borrow pit areas.

STUDY AREA VEGETATION

The undisturbed vegetation types are dominated by coniferous species (western larch, pines, Douglas-fir, western red cedar), although deciduous species such as birch and aspen are common.

The closed canopy forest occurs on south facing slopes (5%-40%) of an eroded sandy terrace.

The shrub layer in these stands commonly contains redstem ceanothus, mahonia (Mahonia aquifolium (Pursh) Nutt.) prickly rose (Rosa acicularis Lindl.), waxberry, thimbleberry (Rubus parviflorus Nutt.), spreading dogbane, mallow ninebark (Physocarpus malvaceus (Greene) Kuntz), and false box. Shrub and herb cover is reduced on steeper slopes. Wintergreen (Pyrola asarifolia Michx.), sarsaparilla, bearberry, queen's cup (Clintonia uniflora (Shult.) Kunth), northern bedstraw (Galium boreale L.), and creeping mahonia (Mahonia repens Lindl.) are common ground cover herbs in these closed canopy forests.

An irregular ridge of bedrock occurs above Robson and occasional outcrops are evident elsewhere in the sub-area. An open-canopy mixed wood vegetation type occurs on these thin soil sites. Open canopy forests on these rocky ridges and outcrops are dominated by lodgepole and ponderosa pine. The shrub layer on these sites is well developed and is dominated by Saskatoon berry, ocean spray, redstem ceanothus and waxberry. Ground cover species are pinegrass, lupine, yarrow and bearberry.

Site descriptions 2, 3, and 4 in Appendix B describe representative plots located in the upland portion of sub-area 1.

SUB-AREA 2:
COLUMBIA RIVER SOUTH (HUGH KEENLEYSIDE DAM TO CASTLEGAR)

General

A fairly uniform, closed canopy mixed wood forest on north facing slopes is common throughout this sub-area.

Riparian and Lowland Vegetation

The south bank of the Columbia River from the east end of the B.C. Timber Ltd. pulpmill property to Castlegar supports a closed canopy stand of black cottonwood, birch, and a few conifers (mainly pines, western larch and Douglas-fir).

The western portion of the sub-area has been heavily disturbed by the pulpmill, sawmill, land clearing, and borrow pits near the Keenleyside Dam.

Some regeneration of shrubs and trees, especially black cottonwood and birch, has occurred along roadsides and the Canadian Pacific Railway.

Upland Vegetation

Generally all uplands within the study area (up to EL 800 m a.s.l.) are coarse colluvium or sandy, eroded, fluvial terraces.

With the exception of a few small areas of rocky outcrops and the cleared transmission line right-of-way, the forest is relatively evenly aged (approximately 60-75 years), with a closed canopy and a complete mixture of deciduous and coniferous species. Typically, Douglas-fir, western red cedar,

western larch, aspen, white birch, white pine, lodgepole pine, and ponderosa pine can be found growing together.

Shrub layers are not well developed in the dense, steep-sloped stands. However where they do exist, spreading dogbane, black blueberry, mahonia, false box, prickly rose, Douglas maple (Acer glabrum Torr.), blue clematis (Clematis columbiana T. & G.), waxberry and others are common.

Common herbs in this vegetation type include rattlesnake plantain (Goodyera oblongifolia Raf.), prince's pine, twisted stalk (Streptopus amplexifolius (L.) DC.), queen's cup, and false Solomon's seal (Smilacina racemosa (L.) Desf.).

Most trees have been cleared from the transmission line right-of-way and two cultivated fields are located on a terrace near Castlegar, at approximately 600 m a.s.l. Agronomic grass species dominate the ground cover of these areas.

Site description 1 in Appendix B is of a representative plot located in the upland area of sub-area 2.

SUB-AREA 3: PASS CREEK

General

This sub-area extends from the confluence of Pass Creek to several kilometers upstream in the Pass Creek Valley. Vegetation types vary considerably up the valley because there is about a 200 m rise in elevation over an 8 km distance.

The mountain slopes on the east side of the Pass Creek Valley were burned in a 1967 forest fire.

STUDY AREA VEGETATION

Riparian and Lowland Vegetation

Much of the natural vegetation along the lower portions of Pass Creek has been cleared for agriculture, housing, railway right-of-way, roads and sewage lagoons.

Additional clearing has taken place to create the Pass Creek Regional Park.

North or upstream of Pass Creek Regional Park, lowland vegetation is generally a closed canopy mixed wood forest. Black cottonwood, maple, birch, and willow are the most common deciduous species. However, Douglas-fir, white pine, western larch, red cedar, hemlock, grand fir, and yew also occur along the banks of the creek and low sandy alluvial terraces of the Pass Creek Valley. Above the waterfall on Pass Creek the riparian vegetation is predominantly coniferous, being composed of larch, Douglas-fir and hemlock with some pine, birch, red cedar, aspen, and black cottonwood.

The shrub and herb layers of these fairly dense lowland forests are not well developed as many species are intolerant of shade. However, yew, maple, hazelnut (Corylus cornuta Marsh.), prickly rose, and redstem ceanothus occur in the shrub layer along Pass Creek. Typical herbs are horsetail (Equisetum arvense L., sedges (Carex spp.), rushes (Juncus spp.), and grasses which occur in wet depressions and along stream banks. Other species include sarsaparilla, false box, buttercup, (Ranunculus spp.), star-flowered Solomon's seal, twisted stalk, queen's cup, rattlesnake plantain, indian pipe (Monotropa uniflora L.), and others.

Site description 7 in Appendix B is of a representative plot located in the lowland area of sub-area 3.

STUDY AREA VEGETATION

Upland Vegetation

As previously mentioned, much of the mature upland vegetation of the lower Pass Creek Valley has been destroyed by fire and land clearing.

On undisturbed sites conifers dominate. Slopes under these closed canopy forests are usually relatively steep, ranging from 25 to 50 percent. Douglas-fir, white pine, ponderosa pine, and lodgepole pine are the most common species although birch, black cottonwood, and aspen occur throughout.

Seral plant communities which developed following the 1967 forest fire are now well established. Shrubs, to a height of approximately 3 m, occupy the lower slopes. Dense shrub thickets of hazelnut, redstem ceanothus, waxberry, prickly rose, red elderberry (Sambucus racemosa L.), and willow occur on the dry sites of the burned area. Wetter draws or ravines support birch up to 15 m in height.

Several clearings occur between the dense thickets of shrubs. Common plants of these areas are bracken, lupine, and several species of grasses.

Site descriptions 5 and 6 in Appendix B describe representative plots located in the upland area of sub-area 3.

SUB-AREA 4: KOOTENAY RIVER

General

Most of the natural vegetation within this sub-area has been altered or disturbed by land clearing, highway, bridge and dam

construction, plus industrial, institutional, and residential developments. The main area of undisturbed vegetation occurs between Selkirk College and the bridge near Castlegar Airport.

Riparian and Lowland Vegetation

The lowland vegetation which occurs on the Kootenay River and Brilliant alluvial fans consists of scattered willow and grasses. Both fans have been cleared for hay production and fruit trees. Both are covered by agronomic grass species and weedy species along the banks of the Kootenay River.

A narrow band of willow, birch, black cottonwood and black hawthorn (Crataegus douglasii Lindl.), has developed along an intermittent channel south of the Kootenay River.

A clearing is located on a lowland terrace below Selkirk College. It is dominated by grasses and knapweed with scattered hawthorn, redstem ceanothus, and willow. This area is gently undulating and has been used as a motorcross circuit. Although the track has disturbed some of the lowland vegetation, little damage has been done to other plants in the area.

One small pocket of muck soil occurs in the area. The depression is dominated by sedge and a few cattails (Typha latifolia L.).

A small plantation of young Douglas-fir has been established on a lower terrace between the Selkirk College access road and the river. This plantation, which is above EL 430 m, is a project of the College. Other deciduous shrubs and trees, especially Saskatoon berry, birch, and hazelnut occur on this terrace.

STUDY AREA VEGETATION

A closed canopy mixed wood forest occurs on the terrace slopes above the river near the north end of the airport. Birch, white pine, red cedar, lodgepole pine and Douglas-fir dominate the overstory. Rocky Mountain juniper trees (Juniperus scopularum Sarg.) 1 to 3 m in height and mountain alder (Alnus tenufolia Nutt. Pursh) occur in a narrow band on the cobbly, rocky soils along the river bank.

The understory below the mixed wood forest is diverse. Shrubs include bracken, hazelnut, huckleberry, spreading dogbane, ocean spray, redstem ceanothus, Saskatoon berry, mahonia, maple and honeysuckle (Lonicera ciliosa (Pursh) DC.). Herbs found include grasses, queen's cup, bearberry (on gravel near river), purple vetch (Vicia spp.), sarsaparilla, bluebell (Campanula rotundifolia L.), and poison ivy.

Site description 14 in Appendix B is of a representative plot located in the lowland area of sub-area 4.

Upland Vegetation

The uplands north of the Kootenay River are intersected by highways, access roads, a gravel pit, railway, transmission line right-of-way, and a natural gas pipeline right-of-way.

The remaining vegetation on the rocky lower slopes is open canopy forest of pine with some Douglas-fir. Rocky outcrops and sites with shallow soils are dominated by shrubs and herbs, especially redstem ceanothus, hazelnut, mahonia, lupine and ocean spray.

A closed canopy mixed woodland occurs on the steep lower slopes of the south side of the Kootenay River. Typical species here are birch, larch, pine, Douglas-fir and red cedar.

SUB-AREA 5: CASTLEGAR - KINNAIRD

General

The sub-area encompasses an urban built-up area. Much of the natural vegetation has been radically altered by settlement patterns.

Riparian and Lowland Vegetation

Black cottonwood, birch, willow, and occasionally juniper occur on the west bank of the Columbia River. Willows, grasses, and weedy species, such as knapweed, have invaded the sand and gravel bars near the City of Castlegar. Creek beds and islands support black cottonwood and birch.

Upland Vegetation

Vegetation located on the lower slopes west of Castlegar is relatively undisturbed, and a fairly dense mixed wood forest occurs on sandy soils in this area. Open canopy forests occur on rock outcrops similar to the situation described in sub-area 1.

Typical tree species include birch, Douglas-fir and ponderosa pine. Plum trees, probably an escaped domestic variety, are also found. Shrub cover is variable depending upon density of the stand. Shrubs are best developed on the thin soil - rock outcrop areas. Hazelnut, willow, maple, false box, mahonia, prickly rose, waxberry and Saskatoon berry are frequently found.

Land clearing for residential developments and the construction of an industrial park has disturbed vegetation above Kinnaird. The remaining vegetation is not unlike the open and closed forests previously described for the upland slopes above Castlegar.

Site descriptions 8, 9, and 10 in Appendix B are of representative plots located in the upland areas of sub-area 5.

SUB-AREA 6: CASTLEGAR AIRPORT

General

Vegetation in this sub-area varies from an open canopy shrub-tree type which occurs on the thin soils of rocky outcrops near the golf course, to cleared fields or orchards in the settled areas of Ootischenia, to the closed canopy mixed woods of the Cai Creek area near the transmission line crossing of the Columbia River north of Blueberry Creek.

Riparian and Lowland Vegetation

With the exception of a large sand-gravel bar which is located approximately midway in the sub-area (at Waterloo Eddy), the east bank of the river is covered by a closed canopy mixed wood forest. The dominant tree species are cottonwood and birch. However, pine, Douglas-fir, juniper, larch and red cedar can also be found.

Shrub and herb cover varies according to slope and soil texture. Generally, however, the species previously described in the riparian vegetation section of sub-area 5 also occur here.

STUDY AREA VEGETATION

Upland Vegetation

The open canopy shrub community which occurs above the airport near the Castlegar golf course is a diverse habitat of clearings, shrubs, herbs, mosses, and lichens growing on thin soils and exposed rocky outcrops. Redstem ceanothus, bracken, lupine and grasses dominate these areas although individual and small clumps of white pine and lodgepole pine also occur.

Shrub thickets are dominated by hazelnut, mountain alder, honeysuckle, thimbleberry, birch and maple. These plant communities appear to be succeeding to birch dominant mixed woods.

The vegetation of the cleared/settled areas of Ootischenia has been disturbed by past land clearing activities. There are several small backyard orchards and hobby farms in this area which are believed to be the source of the stray fruit trees which are established on the slopes and terraces above the area. The seeds of these trees have probably been transported to the adjacent areas by birds.

The forested portion in the south end of the sub-area is a closed canopy mixed woodland dominated by birch, pine and larch, with some Douglas-fir and western red cedar. False box, spreading dogbane, redstem ceanothus, and ocean spray are common shrubs in this area.

SUB-AREA 7: CHAMPION AND JORDAN CREEKS

General

This sub-area is located on the east side of the Columbia River and includes all of the Champion Creek fan. It extends to the

confluence of Jordan Creek (across from Genelle). The dominant landform feature of this sub-area is the Champion Creek fan, which is completely cleared and consists largely of abandoned orchard.

Riparian and Lowland Vegetation

Riparian vegetation in this sub-area is not well developed except in the southern portion of the area from approximately the confluence of Champion Creek to the confluence of Jordan Creek.

Elsewhere, vegetation is not established along the banks of the river because of past land clearing activities (Champion Creek fan) or because the bank is too steep.

The riparian vegetation between Champion and Jordan Creeks is not unlike other closed canopy mixed woods described elsewhere. It is dominated by birch and cottonwood and contains most of the other coniferous tree species and shrubs described for previous sub-areas.

Site description 15 in Appendix B is of a representative plot located in the lowland portion of sub-area 7.

Upland Vegetation

Champion Creek fan is probably the most significant feature of the sub-area. The fan is the largest in the study area and with the exception of some planted fruit and ornamental trees such as Lombardy poplar (Populus nigra L. var italica Duroi) the fan has been completely cleared.

STUDY AREA VEGETATION

A large abandoned area of orchard still stands on the fan. White pine, ponderosa pine, and lodgepole pine appear to be invading the fan from the margins. The main shrub species present in depressional areas and at the edges of once cultivated fields include redstem ceanothus, prickly rose, black hawthorn, hazelnut, and Saskatoon berry.

Herbs such as poison ivy, bluebell, and bearberry are common on the steep, gravel to sandy slopes which lead down to Champion Creek.

Cattle and horses graze on the fan and on the lowlands of the creek. This domestic stock grazing as well as wild ungulate browsing probably is responsible for the retardation of succession of the development of shrubs and trees on this abandoned grassland area.

A closed canopy mixed wood forest occurs from the southern edge of the Champion Creek fan to Jordan Creek. Black cottonwood, lodgepole pine, red cedar, and birch dominate the creek bed and adjacent lands. Black cottonwood is replaced by birch and larch on higher, better-drained sites. Shrubs of this forest include willow, hawthorn (up to 4 m high on wet sites), Saskatoon berry, red osier dogwood, prickly rose, mock orange, and hazelnut. Forget-me-not (Myosotis sylvatica Hoffm.), wild strawberry (Fragaria virginiana Duchesne), horsetail and bluebells grow on the sandy banks of Champion Creek. Elsewhere on drier sites, the herb species are similar to those described in previous sections.

STUDY AREA VEGETATION

SUB-AREA 8: BLUEBERRY CREEK TO GENELLE

General

Much of the natural vegetation of this sub-area has been cleared for housing, roads, highways, and rights-of-way. The lowlands of Blueberry and China Creeks, however, are relatively undisturbed.

Riparian and Lowland Vegetation

Willow, black cottonwood, and various shrubs are established on the gravel bars along the river from south of Blueberry Creek and from Poupore to Genelle. This sub-area is the first to contain any sand and gravel bars of significant size.

The lowlands of Blueberry Creek and China Creek fans contain black cottonwood and birch. Douglas-fir, lodgepole pine, and ponderosa pine also occur on the lower portions of these two alluvial fans.

Typical shrubs and herbs found in the sub-area include hazelnut, Saskatoon berry, mock orange, maple, willow, prickly rose, thimbleberry, mahonia, huckleberry, spreading dogbane, birch-leaf spirea (Spirea betulifolia Pall.), and heart-leaved arnica (Arnica cordifolia Hook.).

Site description 11 in Appendix B is of a representative plot located in the lowland portion of sub-area 8.

Upland Vegetation

Upland vegetation in this sub-area is similar to the diverse habitats found in sub-area 6. Rocky outcrops dominated by

birch and pine occur throughout the sub-area. Wetter sites and terrace areas with deeper soils support a mixed assemblage of birch, pine, larch, and Douglas-fir. Older stands of western hemlock (age approximately 75 years) were found to occur on wetter sites. However, hemlock was not found to be a dominant species anywhere in the study area.

Site description 12 in Appendix B is of a representative plot located in the upland area of sub-area 8.

SUB-AREA 9: BILLY CREEK

General

The sub-area encompasses land on the east side of the Columbia River from Jordan Creek to Billy Creek (located across from the proposed damsite at Oasis). Sparsely vegetated steep cliffs and rocky outcrops dominate along this stretch of the river.

Riparian and Lowland Vegetation

The open canopy birch and pine forest occurs along the lower terrace edge and extends downslope onto the bank of the Columbia River in places. On the less steep and rocky sites a closed canopy mixed wood forest occurs. These two forest types appear to be approximately equal in extent throughout the sub-area.

Upland Vegetation

Birch dominates the upland vegetation in the sub-area. The steep cliffs and rocky outcrops found all along this stretch of the river are sparsely vegetated. Shrubs such as redstem

ceanothus are commonly found on these rocky sites as are Saskatoon berry, lodgepole pine, larch, stonecrop (Sedum spp.), and grasses. Talus slopes occur below some of the actively eroding steep bluffs. Few vascular plants occur on these sites.

SUB-AREA 10: OASIS (Including the Murphy Creek Till Site)

General

A wide diversity of vegetation types occur in this sub-area. Much of the vegetation on the lower slopes and terraces near the Columbia River has been cleared. Non-native trees, especially black locust, have been planted along roadsides.

Topographic variation from wet creek bottoms to dry rocky outcrops is also responsible for the diversity of vegetation found in this sub-area.

Riparian and Lowland Vegetation

Willow, cottonwood, and grasses are invading sand and gravel bars throughout the sub-area.

Because the banks of the Columbia River are fairly steep and rocky, limited tree growth has occurred. A major area of exception is the closed canopy forest of black cottonwood, birch and willow which occurs at the mouth of Murphy and Hanna Creeks.

STUDY AREA VEGETATION

Upland Vegetation

A closed canopy mixed wood dominated by birch, larch, and pine occurs on the terraces and lower slopes. Much of this vegetation type has been removed for the highway, roads, rights-of-way, housing, and golf course that have been developed in this area.

This particular sub-area appears to be more rugged than others. The vegetation on the rocky outcrops is open canopy, and generally dominated by shrubs such as redstem ceanothus and hazelnut.

Black locust has been planted at several locations in this sub-area (for example, along the old highway at Murphy Creek, Oasis, and Riverdale). This non-native tree has established itself well in the area and appears to be actively spreading from the original trees planted some thirty years ago.

The Cominco Smelter at Trail has been cited as a source of sulphur dioxide (SO_2) gas which has damaged vegetation in the Columbia Valley. Sulphur dioxide emissions reached a peak in the late 1920's. However, there has been a gradual recovery in the vegetation since pollution control devices were installed in the smelter in 1940 (Archibold 1974).

Site description 13 in Appendix B is of a plot located in the upland portion of sub-area 10.

Murphy Creek Till Site

Three potential sources of till material for use in the construction of the Murphy Creek dam were selected by B.C.

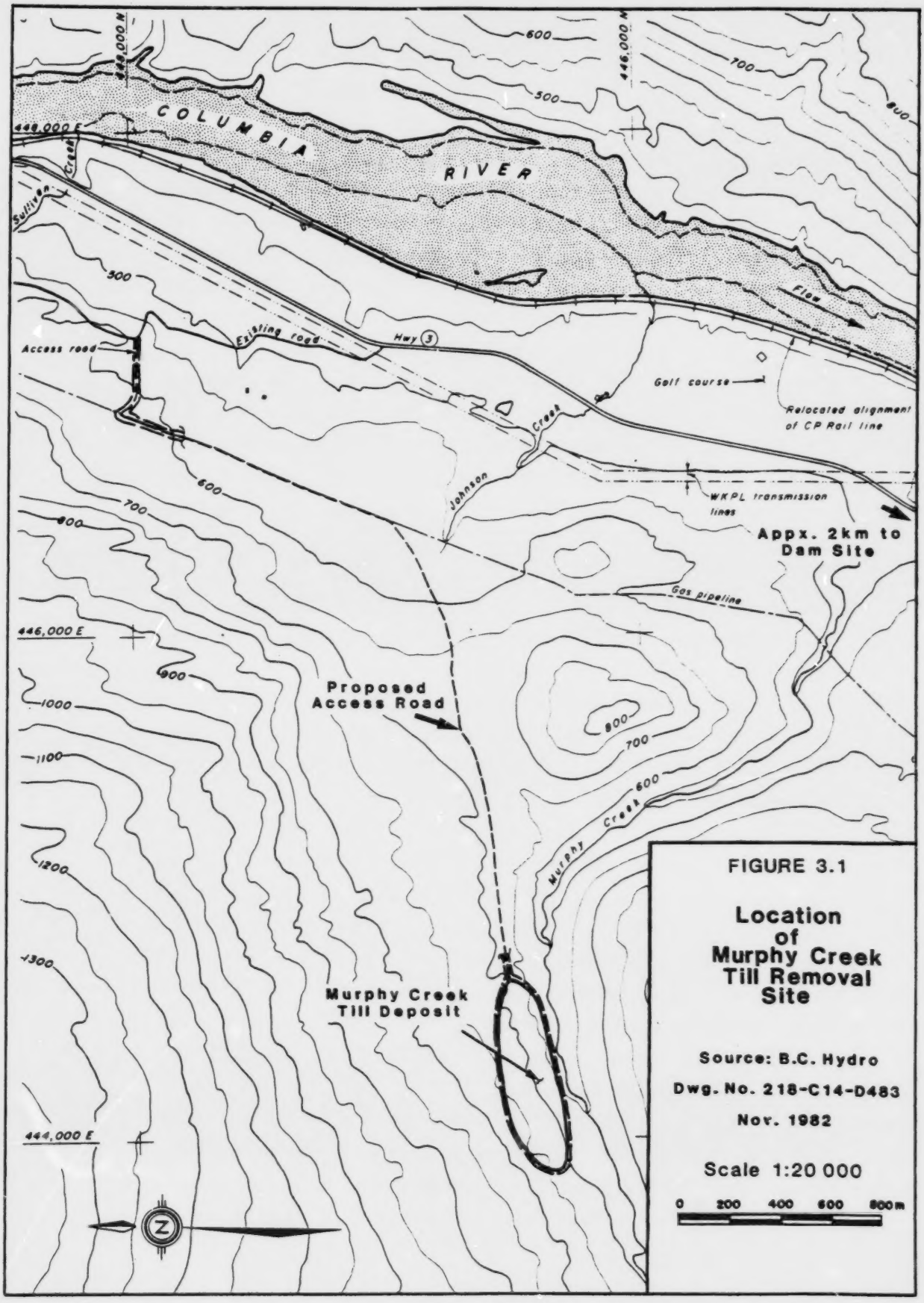
Hydro near the end of the environmental field studies. The Murphy Creek, Sullivan Creek and Hanna Creek till sites, located on the west side of the Columbia River, were identified as possible till sites. The Sullivan Creek and Hanna Creek sites were not investigated in any detail as these two locations were found to contain unsuitable materials. The discussion that follows is therefore limited to a general description of the vegetation resources of the Murphy Creek till site (Figure 3.1). An overview assessment of vegetation impacts associated with developing the 17 ha pit and 12 ha access road is presented in the following chapter.

The vegetation resource description and impact assessment are based upon examination of available published data. No field work was performed by Talisman personnel. However, information in the form of aerial photographs, field notes from other study team members (Beak Consultants), forest cover maps and BCLI forest capability maps was examined to identify general vegetation features and assess the impact of site development. Details regarding land ownership and tenure were not determined.

An immature mixed coniferous-deciduous forest characterizes the till site. The B.C. Ministry of Forests classifies the area as a medium quality forest site, as volumes per hectare are generally moderate to low.

Field studies conducted by Beak Consultants near the site revealed that:

> The vegetation in this area showed a strong response to aspect. The south aspects were dominated by a broad leaf forest. Birch was the most abundant tree species; however, others of importance were black


COLUMBIA RIVER
Flow
Existing road
Hwy 3
Access road
Golf course
Relocated alignment of CP Rail line
WKPL transmission lines
Appx. 2km to Dam Site
Gas pipeline
Proposed Access Road
Murphy Creek Till Deposit
Murphy Creek
Johnson Creek
Sullivan Creek
448,000 N
446,000 N
448,000 E
446,000 E
444,000 E
500
600
700
800
900
1000
1100
1200
1300
FIGURE 3.1
Location of Murphy Creek Till Removal Site
Source: B.C. Hydro
Dwg. No. 218-C14-D483
Nov. 1982
Scale 1:20 000
0 200 400 600 800m

cottonwood, mountain alder, western larch, and trembling aspen. The understory species included Saskatoon, willow, hazelnut, waxberry, mahonia and false box. The ground flora was predominantly grass, bearberry and moss with few other species. Trembling aspen gained importance with an increase in elevation until, at a level of approximately 2,800 feet, the clones of aspen dominated the area. The inter-clonal areas were occupied by Saskatoon, Rocky Mountain juniper and waxberry. Hazelnut and mahonia were also common but scattered in their distribution. The understory was comprised of abundant grasses, mosses and bearberry.

The north and northeast aspects along Murphy Creek were almost exclusively dense western larch with very few other species interspersed. The understory was also restricted; false box was the only abundant species although Saskatoon, willow and hazelnut occupied sporadically. The groundcover was restricted to primarily moss, grass and bearberry.

The riparian vegetation of the Murphy Creek till site was characterized by a closed mixed forest. White birch was the most abundant tree species, followed by black cottonwood and western larch. Alder was ubiquitous in a single band along either riverbank. Tree species which occurred sporadically in the area were Douglas maple, western hemlock, Douglas-fir, red cedar, white pine and grand fir.

The understory was relatively dense. Thimbleberry, snowberry, and false box were the most abundant shrubs. Others occurring in a scattered distribution

were red osier dogwood, hazelnut, blue elderberry, mahonia, mock orange, red-stem ceanothus and black blueberry.

The ground cover in these riparian areas was sparse. Commonly occurring species (though never abundant) were twinflower, prince's pine, marsh violet, bearberry, starflowered solomon's seal, bracken fern and horsetail.[1]

PLANT SPECIES LIST

A comprehensive list of plant species encountered in the study area is contained in Appendix C. Most of the species listed have been referenced in the above discussion, with the exception of a few less commonly found species which appear only in the Appendix.

[1]Notes on Field Survey, Beak Consultants Ltd.

CHAPTER 4

VEGETATION IMPACT EVALUATION

ASSUMPTIONS AND METHODS

This chapter assesses the possible impacts of the proposed Murphy Creek dam, reservoir, and ancillary works on the vegetation resources of the study area. The impacts for each of the ten sub-areas are presented separately. The assessment involves identification of potential impacts, due to inundation or construction, on the vegetation resources along or near the Columbia River and its tributaries at reservoir level EL 424 m. The potential impacts of the project at the two higher reservoir levels of EL 427 m and EL 430 m initially assessed in the environmental studies are also presented for comparison. Impacts have been assessed for each sub-area.

Based on discussions with B.C. Hydro project staff, it has been assumed that, prior to reservoir filling, all standing vegetation below the proposed operating level would be removed for aesthetic and navigation or safety reasons. The clearing and grubbing of vegetation below the water line of the proposed reservoir is considered to be a direct and permanent loss to the vegetation resource base of the study area.

VEGETATION IMPACT EVALUATION

Each of the following sub-area discussions presents an estimate of the loss of vegetation at the three reservoir levels considered. It was assumed for this assessment that direct impacts would be additive as the water levels were increased. For example, the impacts of the clearing of vegetation from the existing shoreline to contour line 424 is presented first in terms of hectares lost to EL 424 m. If the water level of the reservoir were set at 427 m, an additional loss of vegetation would be expected. Similarly there will be an additional loss of vegetation between EL 427 m and EL 430 m. A table summarizing the area of vegetation which could be lost to the resource base at EL 424 m is presented in the last section of this chapter. Vegetation losses expected at higher reservoir levels initially considered as part of the environmental studies (EL 427 m and EL 430 m) are presented for comparison.

In addition, a discussion of possible vegetation impacts due to construction of works associated with the dam and till site development is presented for sub-areas 9 and 10. The preliminary damsite works considered are those described in the draft document Murphy Creek Project Engineering Description prepared by B.C. Hydro in November, 1982 (B.C. Hydro, 1982a). Conceptual layouts of required highway, railway, and transmission line rights-of-way relocation associated with damsite construction were assessed as part of the damsite considerations, based on a B.C. Hydro drawing of November, 1982 (B.C. Hydro, 1982b). The proposed relocation of the CPR rail line in the Birchbank area necessitated by the project was assessed as outlined in Murphy Creek Hydroelectric Development Impact on Existing CP Rail Facilities (Thurber, 1982). Proposed construction areas, including spoil areas associated with dam construction, were assessed based on a B.C. Hydro drawing of November, 1982 (B.C. Hydro, 1982c). All of these plans are preliminary and conceptual in nature, and as such, are subject to revision.

VEGETATION IMPACT EVALUATION

Finally, on the basis of a preliminary terrain analysis carried out by Thurber Consultants Ltd. (Thurber, 1980) and Pedology Consultants Ltd. (Pedology, 1979), and preliminary B.C. Hydro proposals for bank protection, berming and filling of depressional areas (B.C. Hydro, 1982d,e,f), possible impacts associated with erosion, slumping, and filling were identified.

The main assumptions and methods for determining the areas impacted by the proposed reservoir are as follows:

* all areas were determined from digitized vegetation maps (scale 1:10,000). These vegetation maps were prepared from air photos and field checked by Talisman personnel. These estimates were later checked against 1:2500 and 1:1250 scale mapping and no changes were deemed to be warranted.

* it was assumed that all direct and most indirect impacts on vegetation would be limited to those vegetation types which are directly connected to or near the Columbia River, Kootenay River or the numerous tributary creeks which flow into the Columbia River within the study area.

* the area of each vegetation type or polygon was digitized and recorded. For example the area between the present shoreline vegetation (as it appears on 1978 and 1979 aerial photographs and the 1:10,000 orthophoto prints) and EL 424 m was determined, as were the areas between 424 and 427 m, 427 to 430 m and 430 m to the border of the polygon. For damsite and associated works, the areas of the potentially affected polygons

were determined by direct measurement from conceptual plans outlining the areas to be occupied by these works.

Limitations

It should be recognized that this method of determining vegetated areas which could be lost to the proposed dam, till site and reservoir has several limitations which probably has resulted in slightly inaccurate estimates of the direct losses of vegetated land. These limitations include:

* error due to the difficulty in accurately measuring the area of small or narrow polygons, and those steep areas such as river banks where the three reservoir levels occur close together on a horizontal plane.

* error due to the type lines of some polygons obscuring the topographic information on the base map.

* error due to a lack of detailed topographic information for about 1.6 km of sub-areas 9 and 10, immediately upstream of the proposed damsite area. Potential inundation in these areas was not estimated.

However, even with these minor problems, the following impact assessment is considered to reflect, within reasonable limits of accuracy, the potential losses of vegetated lowland due to the construction of the proposed Murphy Creek dam and the clearing of the reservoir area. Digitizing error is estimated to be within ± 5%. The amount of error in topographic mapping is typically ± 1/2 contour interval.

VEGETATION IMPACT EVALUATION

SUB-AREA 1:
COLUMBIA RIVER NORTH (HUGH KEENLEYSIDE DAM TO ROBSON)

This sub-area extends along the north shore of the Columbia River from the Hugh Keenleyside damsite to the community of Robson.

The natural vegetation of the western portion of the sub-area has been cleared and disturbed by highway and dam construction. The banks of the river are generally bare or lightly vegetated with weedy species such as thistle and knapweed. The vegetation impacts of increasing the water levels for the proposed reservoir in the western third of the sub-area are neglible and were not recorded.

The eastern, remaining portion of the sub-area is dominated by a closed canopy mixed wood vegetation type which occurs in the vicinity of Robson between the highway and north bank of the Columbia River. This narrow band of vegetation occurs on a relatively steep slope. Approximately 4 ha of deciduous shrubs and trees would require clearing between the present shoreline vegetation and the proposed 424 m reservoir level. An additional 3 ha would be lost at water level 427 m and another 8 ha should the maximum reservoir level be set at 430 m. At the highest level roughly one half of this greenbelt would require removal. This particular strip of vegetation is believed to be an important buffer between the houses of west Robson and the river. Also it is likely to be an important aesthetic and local recreational area. The toe protection and berming proposed for much of the shoreline of this sub-area is expected to provide this narrow band of vegetation, which is situated on a fairly steep bank, with adequate protection from bank erosion potentially caused by the project.

SUB-AREA 2:
COLUMBIA RIVER SOUTH (HUGH KEENLEYSIDE DAM TO CASTLEGAR)

Situated along the south bank of the Columbia River between the Hugh Keenleyside damsite and west Castlegar, the vegetation of this sub-area closely resembles that of sub-area 1. Much of the riparian vegetation of the sub-area has been removed or disturbed due to railway, road, and dam construction plus the B.C. Timber Ltd. pulpmill and sawmill, landfills and access roads. As with sub-area 1, the vegetation impacts of raised water levels on the disturbed portions of the sub-area were not assessed.

The main vegetation concern of the sub-area concerns a closed canopy band of mixed wood forest which occurs between the shoreline and the Canadian Pacific Railway tracks. With the proposed 424 m water level, approximately 4 ha of birch, black cottonwood, willow and other trees and shrubs will require removal. An additional 3 ha would be lost at EL 427 m and about another 2 ha should the maximum water level be established at 430 m.

In addition, minor amounts of this vegetation unit may be lost as a result of bank erosion caused by increased water levels. Toe protection is proposed only in selected areas along the approximately 3 km of shoreline bordered by this unit.

SUB-AREA 3: PASS CREEK

The Pass Creek lowlands are located on the north bank of the Columbia River east of Robson. The lowlands and alluvial fan area are a complex of mature closed canopy mixed wood forest interspersed with shrubby clearings, pastures and some rural

housing. The overstory has been removed in several areas for recreational, residential and agricultural use. Even though this disturbance of natural vegetation cover has taken place, the Pass Creek lowlands represent one of the most botanically diverse portions of the entire study area.

There are three main components to the Pass Creek lowlands. The components are similar botanically but have been separated to simplify the assessment and because the railway embankment and the highway present obvious boundaries.

The impacts on each of the three components are as follows:

* The first area is comprised of the lower Pass Creek fan. Bounded by the highway to the north, the Columbia River to the south and the CPR tracks to the east, this area is dominated by deciduous shrubs and trees (especially black cottonwood and willow) which occur along the banks of the river and Pass Creek. It also contains a mature mixed wood stand near the railway tracks and along the road and highway. At the proposed water level of 424 m all of the exposed sand and gravel bars which occur at the confluence would be inundated.[1] Approximately 2 ha of the birch, cottonwood, and willow stand which occurs at the confluence of Pass Creek and the Columbia River would require clearing. At water levels EL 427 m and EL 430 m an additional 2 ha of this vegetation type would be inundated. An additional 5 ha of

[1]Sand and gravel bars in this area are unvegetated. Therefore the innundation of these sites has not been specifically assessed in this report.

shrubs, 5 ha of closed canopy mixed wood forest, 8 ha of open canopy deciduous forest and pastureland, and about 10 ha of sparsely vegetated floodplain would be inundated at EL 427 m and EL 430 m.

* The second component of the Pass Creek lowlands lies east of the CPR tracks and includes the sewage lagoon, the island and adjacent riparian vegetation. The sewage lagoon area and access road occupies about one half of the land of this component. Little or no damage to natural vegetation in the lagoon area is anticipated. However, a closed canopy stand of deciduous shrubs and trees occurs along the river bank east of the lagoons. Approximately 2 ha of this vegetation type would require clearing at the proposed reservoir levels in excess of EL 424 m. At the proposed 424 m level, the railway right-of-way does not require relocation, which it would at higher reservoir levels. No additional vegetation impacts are therefore associated with right-of-way relocation for a reservoir level of 424 m.

* The third part of the Pass Creek lowlands lies north of the highway between the Pass Valley road and the eastern portion of the Pass Creek/Robson settlement. This component contains all of the lowland forest as well as the cleared land of the Pass Creek Regional Park, and includes both sides of Pass Creek upstream to the base of the Pass Creek waterfall. Most of the Pass Creek Regional Park occurs at elevations below 424 m. Therefore without some form of flood protection, water from the proposed reservoir (EL 424 m) would cover about 20 ha of mixed woods, ponds, the park fields, and the lower portions of pastures and hobby farms. At EL 427 m approximately 40 ha of natural vegetation,

agricultural land and developed land would be inundated. An additional 5 ha could be innundated at EL 430 m. These impacts would be most significant near the highway and would be diminished up Pass Creek Valley due to the narrowing of the floodplain, and because the gradient of Pass Creek increases near the waterfall.

No significant bank erosion impacts are projected in this sub-area and accordingly no further vegetation impacts have been identified.

SUB-AREA 4: KOOTENAY RIVER

This sub-area includes the Kootenay River fan and the east bank of the Columbia River from Selkirk College to the Highway No. 3 bridge crossing near the Castlegar airport.

Much of the natural vegetation within the sub-area has been cleared for agriculture or settlements. The loss of agricultural land in this sub-area is assessed in an alternate report on agriculture. The assessment here will be restricted to natural vegetation types.

On the Brilliant side of the Kootenay River fan approximately 1 ha of open canopy mixed wood forest would require clearing at the proposed reservoir level of EL 424 m. This vegetation occurs along the east bank of the Columbia River. The remaining 1 ha of this stand would be inundated at water levels in excess of 427 m.

South of the Kootenay River on the Kootenay fan lowlands and Selkirk College lowlands, natural vegetation losses increase significantly.

VEGETATION IMPACT EVALUATION

Shrubs and tree stands which occur on the slopes below Selkirk College would suffer direct and indirect losses due to increased water levels. Approximately 5 ha of black cottonwood, birch, hazelnut, and other shrubs will require clearing at the proposed water level of 424 m. An additional 7 ha would be lost at water level 427 m, and about 30 ha more at EL 430 m.

Indirect losses of vegetation may also occur as a result of erosion of the sandy banks and terraces in the vicinity of Selkirk College. The extent of the instability problem near the college is not known pending completion of detailed geotechnical studies. However, continued slumping will result in the loss of stabilizing bank vegetation. Therefore this indirect impact will be an on-going problem until the banks are either stabilized and revegetated through project mitigative measures, or until stabilization and revegetation occur through natural processes. Approximately 2 km of shoreline is involved. No shoreline protection is proposed in this area.

Rocky Mountain juniper was found to occur sporadically in a narrow band along the Columbia River in this sub-area. Increased water levels to EL 424 or higher will likely eliminate this tree from the lowlands of the study area. In a regional context, juniper is not considered a rare or unusual species. However, it does have limited distribution in the study area, and for this reason should be considered a special species.

SUB-AREA 5: CASTLEGAR - KINNAIRD

This sub-area contains the built-up areas of Castlegar-Kinnaird. The area extends from the Castlegar-Robson ferry landing on the southwest bank of the Columbia River, along the river to the transmission line crossing north of Blueberry Creek.

VEGETATION IMPACT EVALUATION

Areas of natural lowland vegetation in this highly developed sub-area are limited to strips of shrubs and trees along the west bank of the Columbia River. Typically the lowland greenbelt stands are composed of black cottonwood, willow, birch, pine and occasionally larch, Douglas-fir, and a variety of common deciduous shrubs. Although these stands are not large, they do provide corridors for wildlife movement, bird and mammal habitats, and local recreational opportunities for residents. In addition this suburban greenbelt has a high aesthetic value.

Approximately 31 ha or about twenty-five percent of the lowland greenbelt in this sub-area would be inundated at the proposed 424 m water level. An additional 15 ha would require clearing at EL 427, and another 15 ha would be lost at EL 430 m. Therefore at the highest water level considered, about one-half of the riparian vegetation in the sub-area would require removal.

Shoreline protection is proposed along most areas of near-shore vegetation potentially impacted by bank erosion. No significant vegetation impacts due to erosion caused by the project are projected.

SUB-AREA 6: CASTLEGAR AIRPORT

This sub-area extends from the Highway No. 3 bridge crossing of the Columbia River along the east bank to the power transmission line river crossing in the vicinity of Blueberry Creek.

Three main vegetation types occur along the river in this sub-area. The first and most extensive type is a closed canopy mixed wood forest which has developed on steep banks. This vegetation type extends from the highway bridge crossing to the

southern end of Ootischenia. A seral, or developing, shrub-grass vegetation type also occurs in the sub-area. The last major vegetation type is an open canopy mixed wood forest. The last two types occur on gentler slopes. For this reason the areas of these types which would be inundated by the reservoir increase considerably at higher possible water levels.

An estimated 4 ha of a closed canopy mixed wood forest would require removal at the proposed water level of 424 m. An additional 1 ha would be affected at EL 427, and because of the relatively steep banks in this portion of the sub-area only an additional 1 ha of mixed wood forest would be lost at EL 430 m. Because the Columbia River banks in this northern portion of the sub-area are erodable, some additional indirect losses of vegetation may occur at all water levels if bank erosion continues to occur. Bank protection works are proposed along about 2 km of shoreline in this sub-area, leaving about 3 km of steep banks unprotected. If bank erosion occurs in these unprotected areas as a result of the project, vegetation disturbances will occur. Such impacts could be quite long term in nature as bank erosion may continue over many years before natural stabilization occurs.

South of Ootischenia, where bank slopes are less steep, greater direct losses of vegetation are expected. It should be noted that the seral and open canopy vegetation types which occur in this area are not generally considered to be aesthetically important compared to the more mature stands; however, these younger vegetation types are probably more important wildlife habitats.

Parts of this southern portion have been cleared for agriculture and the transmission line right-of-way. Approximately 8 ha of these pioneering and seral shrub-grassland communities

will be affected at water level 424 m. An additional 2 ha would be removed from production at EL 427 and another 9 ha at the highest (430 m) water level considered.

The open canopy mixed wood vegetation type which occurs in this sub-area extends along the river near the transmission line crossing, at the southern end of the sub-area. Approximately 1 ha of this type would be inundated at EL 424 m, and another 1 ha at the 427 m water level. The most extensive losses of vegetation would occur at elevation 430 m where an additional 8 ha would be inundated.

SUB-AREA 7: CHAMPION AND JORDAN CREEKS

Located on the east side of the Columbia River, this sub-area includes the Champion Creek fan and extends to Jordan Creek in the south.

Closed canopy mixed wood forests occur on steep banks of the Columbia River and on the lowlands near the two creeks. The Champion Creek fan has been cleared for agriculture and presently is dominated by domestic grasses, decadent fruit trees and a few scattered shrubs. An open canopy mixed wood forest type also is found within the sub-area.

Potential losses of the open canopy mixed wood forest type are estimated to be approximately 12 ha at the proposed 424 m water level, plus an additional 2 ha at water level 427 m, and another 2 ha at EL 430 m.

Losses of grassland and pioneering shrub vegetation which occur along the shoreline of the Columbia River and on the lowest portion of the Champion Creek fan will amount to about 2 ha at

water level EL 424 m. An additional 9 ha of this vegetation would be affected at EL 427, plus another 4 ha at water level 430 m.

Closed canopy mixed wood forest stands which are found in the Champion Creek valley and to a limited extent along the banks of the Columbia River at the southern end of the sub-area will be affected as follows: 5 ha loss at EL 424 m; an additional 5 ha at EL 427 m; plus approximately 3 additional hectares at water level 430 m.

Only a minor portion of the shoreline of the Champion Creek fan and an area opposite Blueberry Creek is proposed to be protected against potential bank erosion caused by the increased water levels to be created by the project. No bank protection is proposed for approximately 6 km of shoreline bordered by steep banks supporting mixed wood forest. Additional long term vegetation disturbances may be created in these areas due to bank erosion caused by the project.

SUB-AREA 8: BLUEBERRY CREEK - GENELLE

This sub-area is located on the west side of the Columbia River, and includes the built-up areas of Blueberry Creek and Genelle which are situated respectively on the Blueberry Creek and China Creek fans. The most widespread impacts on vegetation in this sub-area would occur along the stream banks of Blueberry and China Creeks and on the fans of these two creeks.

Some of the natural forest cover near the settled areas has been cleared for housing, roads, and trails or has been otherwise disturbed. The vegetation on these developed areas has been classified as seral shrub-tree types or open canopy mixed

wood forest. Approximately 26 ha of these vegetation types would be affected at the proposed EL 424 m reservoir level. At EL 427 m an additional 14 ha would be inundated, and another 14 ha would be lost at a EL 430 m reservoir level. Closed canopy mixed wood forest does not have widespread distribution in the sub-area. About 3 ha of this vegetation type would be affected at water level EL 424 m, plus an additional 2 ha at each of the levels EL 427 and EL 430 m.

There are three large sand/gravel bars in this sub-area. Although they are sparsely vegetated they are believed to be used by shorebirds, aquatic mammals, and waterfowl and as recreational sites by local residents. Virtually all of the sand/gravel bar area (43 ha) would be inundated at the lowest reservoir level of EL 424 m.

Bank protection is proposed for about half of the area where potential indirect vegetation losses may occur as a result of the project. In the remaining areas, totalling about 2 km of shoreline, bank erosion created by higher water levels may result in long term vegetation disturbances on the terrace banks.

SUB-AREA 9: BILLY CREEK

The sub-area extends along the east side of the Columbia River from Jordan Creek to Billy Creek. This large sub-area contains a variety of vegetation types ranging from pioneering shrub communities and open canopy mixed wood forests on gently sloping land to closed canopy mixed and deciduous forests on steeper banks.

VEGETATION IMPACT EVALUATION

Approximately 16 ha of closed canopy mixed wood forest would require clearing with a maximum reservoir level of 424 m. An additional 4 ha would be lost at EL 427 m plus another 3 ha at a water level of 430 m.

Open canopy mixed wood vegetation which occurs on the relatively gentle slopes near the Columbia River is commonly found in this sub-area. Potential impacts on this vegetation type are: 16 ha loss at EL 424 m; plus an additional 2 ha at EL 427 m; and about another 4 ha which would be affected at a EL 430 m water level.

Seral or pioneering vegetation is the third and last major vegetation type in the sub-area. Approximately 5 ha of this type would be inundated at EL 424 m. Another 1 ha would be lost at each of the levels EL 427 and EL 430 m.

The estimates of possible areas inundated for this sub-area do not include consideration of approximately 1.6 km of the sub-area immediately upstream of the proposed damsite, as no detailed topographic information was available for this area. However, the Columbia River Valley is quite confined in this reach with very steep slopes, and possible inundation of the closed to open canopy mixed wood forest, as well as the non-vegetated areas that occur along the eastern stream banks, would be limited to a minor area.

In addition to possible inundation, this sub-area contains the eastern portion of the proposed Murphy Creek damsite. Preliminary conceptual design, which is subject to revision, indicates that the works envisioned on the east bank include excavation for construction of a concrete diaphragm wall, one work area, a large borrow area located on the high terrace on which the dam is to be located, and a major spoil area in the

lower portion of the Billy Creek drainage. These areas, totalling about 50 ha, and situated on mixed wood forests, would be stripped of their existing cover but could be reclaimed after construction was completed.

No shoreline protection works are proposed in this sub-area. Additional indirect long term vegetation disturbances from bank erosion created by the proposed higher water level may result along the approximately 7.5 km of shoreline in this sub-area.

SUB-AREA 10: OASIS (Including the Murphy Creek Till Site)

This sub-area is located on the west side of the Columbia River and extends from Genelle to Riverdale. Most of the lowlands in the sub-area are seral shrub-tree types. However closed canopy mixed wood forests occur along the banks of the river south of Genelle at the confluences of Sullivan, Johnson, Murphy, and Hanna Creeks.

It is estimated that approximately 30 ha of seral vegetation would be affected at the proposed 424 m water level. This total would be increased by about 3 ha at each of the higher water levels considered (EL 427 and 430 m). About 20 ha of closed canopy mixed wood vegetation would be affected at EL 424 m. Additional impacts at the two higher levels would not exceed 2 ha. However, as with the previous sub-area, detailed topographic information is not available for about 1.6 km immediately upstream of the proposed damsite area. A considerable portion of this area would be occupied by the proposed works. The remaining area that would be subject to flooding has all been extensively disturbed through past development for roads, railway, and associated uses. Because of the relatively steep slopes found in this portion of the river valley,

possible flooding will be confined to a few hectares. No significant vegetation resources would be affected.

In addition to possible inundation, this sub-area contains the western portion of the proposed Murphy Creek damsite. Preliminary conceptual design, which is subject to revision, indicates that possible works slated for the west bank consist of the dam spillway, powerhouse, one work area, a large rock spoil area along the Columbia River upstream of the dam, a construction camp in the Riverdale area immediately south of the damsite, as well as access roads connecting to Highway No. 22. In addition the present highway and railway rights-of-way would require relocation to the west of their present alignments.

The area required for the spillway and powerhouse configuration would result in the loss of about 5 ha consisting of a pioneering deciduous shrub-tree community. Approximately 3 ha of vegetation would be lost to road and railway relocation around the damsite area. The construction camp would result in the clearing of about 3 ha of deciduous shrub-tree vegetation and the rock spoil/work area located along the west bank of the Columbia River would destroy a 4 ha unit of a pioneering deciduous shrub-tree community. All remaining areas occupied by project works are already severely disturbed and contain little significant vegetation resources.

As well as the proposed project works in the immediate vicinity of the damsite, it is proposed to relocate the railway in the Birchbank area. The proposed relocation would necessitate a major cut and fill operation in which it is estimated that about 6 ha of a closed canopy, mature deciduous forest would be destroyed.

VEGETATION IMPACT EVALUATION

Almost all of the shoreline areas in this sub-area are proposed to be stabilized by bank protection works. An area of approximately 0.5 km in the Birchbank area, where no protection is proposed, may result in minor additional vegetation disturbance.

Most of the areas of vegetation potentially impacted by works associated with damsite construction in this sub-area, including the borrow and spoil areas, could be successfully reclaimed after construction is completed.

Murphy Creek Till Site

The Murphy Creek till site is considered to be relatively sensitive to exploration and open pit excavation, due to its undisturbed nature, diversity of vegetation types and topography.

The 17 ha pit site, and approximately 8 ha of access road will require clearing. This clearing will result in the loss of a total of some 25 ha of immature mixed wood forests. These forested habitats are believed to contain aspen, birch, pine and block cottonwood trees ranging in age from 20 to 60 years. Virtually all shrub and herb species will also be lost at the pit site and along access roads. Long-term losses to the vegetation resource base are expected to be minimal as the site will be reclaimed.

Approximately 4 ha or about one-third of the total area required for the access road to the till site will be contained within the cleared portion of the existing gas pipeline right-of-way. This will serve to reduce the extent of clearing required to develop the site.

VEGETATION IMPACT EVALUATION

STUDY AREA SYNOPSIS

This section of the impact assessment presents a summary for the study area and examines potential impacts in terms of the regional vegetation resource base.

Types of Impacts Encountered

Potential impacts on vegetation have been classified as either direct or indirect. Direct impacts are losses of vegetative cover due to clearing, inundation, or other complete alteration of the supporting soils such that the original vegetation type will not recover following the disturbance. These impacts are considered to be permanent losses to the local and regional vegetation resource base. Other direct impacts may not be permanent. Vegetation losses due to cut banks, borrow operations, temporary access roads, temporary construction camps, and even some fill sites, may be recovered over time as re-vegetation occurs, either through reclamation or natural regeneration. In some cases, the type of revegetation that would occur would not closely resemble the present vegetation, so in one sense it may be argued that a permanent impact exists in these situations. In order to facilitate a distinction between types of impacts, in situations where the long term ability to support vegetative cover has not been completely lost the impact has been termed temporary.

An additional direct impact that may occur as a result of the project is dust creation in the dried-out exposed soils of the drawdown zone. However, since drawdown is scheduled to occur in the late winter and spring months, and this period usually exhibits lower temperatures and incurs sufficient precipitation to prevent excessive drying of exposed soils, this impact is

not expected to be significant under normal operating and climatic conditions. Further, reservoir drawdown would occur infrequently under proposed operating regime 2.

In addition to these direct (or primary) impacts which would occur at the time of project implementation, other secondary or indirect impacts may also occur post-project.

The major impact that falls into this category relates to possible bank erosion or slumping that could be attributed to the project, and the effects of this erosion on the vegetative cover of the area affected. These impacts can also largely be considered as temporary and their severity related to recovery time. Most such disturbances will naturally become revegetated, or stabilize, and with time will likely recover to a vegetation type similar to the one prior to the disturbance.

Temporary vegetation impacts are considered to be either short term (less than 10 years to recover) or long term (greater than 10 years to recover). In this case, most of the temporary impacts, especially those for previously disturbed sites, have been classified as short term and many of these impacts can be ameliorated or reduced with careful planning and reclamation. A later section addresses possible mitigative measures that should be considered.

Summary of Impacts

A summary of the direct losses of vegetation at the three alternative reservoir levels is presented in Table 4.1. This table indicates that approximately 217 ha of lowland vegetation would require clearing for the reservoir at the proposed 424 m reservoir level. The total would increase to 364 ha if a water

Table 4.1

SUMMARY OF DIRECT VEGETATION IMPACTS AT THREE PROPOSED RESERVOIR WATER LEVELS BY SUB-AREA[a,b]

SUB-AREA		AREA, IN HECTARES, OF VEGETATION INUNDATED FROM:		
		RIVER BANK TO EL 424 m	424 TO 427 m	427 TO 430 m
1	Columbia River North Shore	4	3	8
2	Columbia River South Shore	4	3	2
3	Pass Creek	24	70	5
4	Kootenay River	6	8	30
5	Castlegar-Kinnaird	31	15	15
6	Castlegar Airport	13	4	18
7	Champion and Jordan Creeks	19	16	9
8	Blueberry Creek - Genelle	29	16	16
9	Billy Creek	37	7	8
10	Oasis	50	5	5
	SUBTOTAL	217	147	116
	CUMULATIVE TOTAL	217	364	480

[a]Does not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance.

[b]EL 427 m and EL 430 m are no longer being considered but are presented to illustrate comparative losses at the three reservoir operating levels assessed in the environmental studies.

level of 427 m is considered, and at the highest water level studied, EL 430 m, a total of 480 ha of natural vegetation would be lost from the study area's lowland vegetation resource base.

These estimates do not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance. The areas of disclimax plant communities contain no significant areas of tall woody species that would require clearing prior to reservoir filling.

Table 4.2 summarizes direct vegetation impacts related to possible damsite construction. Based on the preliminary conceptual design information provided, a total of approximately 71 ha of natural vegetation would be occupied by cut, fill, spillway, powerhouse works, borrow areas (within the study area), spoil areas, construction camp and work areas, and by necessary highway and railway realignment caused by dam construction. As with the estimates of inundation impacts, these estimates do not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance. Since reclamation of almost all of these areas is possible, these impacts are considered temporary, although it is stressed that the vegetation base after reclamation may be substantially different than the existing vegetation resources in these areas.

None of these potentially impacted areas of vegetation are in Ecological Reserves or in areas for which application for reserve status has been made or is pending.

No bank protection is proposed along approximately 24 km of shoreline in areas where vegetation resources could be affected by bank erosion caused by the project. These areas are princi-

Table 4.2

SUMMARY OF DIRECT VEGETATION IMPACTS
RELATED TO DAMSITE CONSTRUCTION

SUB-AREA		AREA, IN HECTARES, OF VEGETATION[a] OCCUPIED BY WORKS[b]
9	BILLY CREEK	50
10	OASIS (including the Murphy Creek Till Site)	46
	TOTAL	96

[a]Does not include non-vegetated areas, or areas of disclimax plant communities developed after continuous disturbance.

[b]Includes cut and fill areas along proposed dam axis, spillway and powerhouse works, till site, till site access road, spoil areas, construction camp and work areas, and relocation of highway and railway rights-of-way required for dam construction.

pally located in sub-areas 2, 4, 6, 7, 8, and 9, although a minor area has been identified in sub-area 10.

In areas where B.C. Hydro has proposed bank protection, the assumed worst case safeline without protection is typically located 10 m to 20 m in from the existing terrace edge. This project safeline is the result of assumed long-term (70 year) bank slopes (oversteep banks only) of 1:1.5.

Existing banks where a potential erosion hazard has been identified are typically 40 m to 60 m high. Where these banks support significant vegetation resources, these figures suggest that as much as 70 m to 110 m of vegetation (measured on a horizontal plane) may fall within the zone of potential impact. Over the 24 km of shoreline identified, this estimate translates to 168 ha to 264 ha of potentially affected areas. In this worst case scenario, this area of vegetation resources may be subject to long term disturbance by bank erosion over the assumed 70 year life of the project. Most of these disturbances represent temporary impacts. However, an estimated 24 ha to 48 ha of vegetation could be permanently lost over the lifetime of the project. It is stressed that these estimates are highly speculative and are based on a worst case scenario.

In summary, direct and indirect impacts on vegetation are expected to be most widespread and significant at the lowest portions of alluvial fans, at the confluences and valleys of creeks which flow into the Columbia River, and on steep banks above the reservoir where no shoreline protection is proposed. Impacts on vegetation are expected to be highest at the following locations:

* Pass Creek valley and alluvial fan (Sub-Area 3)
* Kootenay River and Selkirk College lowlands (Sub-Area 4)

* Champion Creek valley and alluvial fan (Sub-Area 7)
* Blueberry Creek-China Creek valleys and fans (Sub-Area 8)
* Jordan Creek to Billy Creek lowlands (Sub-Area 9)
* Vegetated steep bank areas where no shoreline protection is proposed

IMPACTS FROM A REGIONAL PERSPECTIVE

Impacts of the proposed Murphy Creek dam and reservoir would be evident throughout the lowlands of the study area. Deciduous forests, mixed wood forests and shrubby communities which occur on the banks and lowlands along or near the Columbia River would be most affected.

It does not appear that any one vegetation type, at the level of type identification carried out in this study, would be totally eliminated from the study area at any of the alternative water levels considered. In most cases, inundation would only affect the lower portions of the type units, with only a few vegetation units potentially totally inundated. These units have been identified in the sub-area impact descriptions.

In terms of plant species documented in this study (Appendix C), the only species identified that would be substantially affected by the project appears to be Rocky Mountain juniper, where the greatest concentration found in the study area occurs in scattered locations along the Columbia River banks, notably in sub-areas 4, 5, 6, and 7. Most of these trees are found below the possible maximum reservoir levels considered in this study and would be lost if the project proceeds. However, sporadic showings of this species in upland areas not subject to possible flooding do occur in the study area, and certainly

in a broader regional context, juniper is not considered to be a rare or unusual species.

There would not be any major loss of coniferous stands. This is documented in the forestry impact assessment presented in a separate environmental assessment study.

Much of the lowland vegetation of the study area has been significantly altered or disturbed through land clearing for settlements, industrial and agricultural land uses, roads, trails, highways, transmission rights-of-way, and other developed uses.

Although most of the vegetation of the area is not in a pristine state, deciduous and mixed wood forests and shrubland vegetation types are highly visible in the study area. They provide wildlife habitats, local recreational areas, and buffer strips, as well as being aesthetically pleasing.

In a regional sense, therefore, the loss of lowland vegetation, however limited, is considered significant. This is particularly true in the Castlegar-Trail area where nearby impoundments on the Columbia, Kootenay, and Pend Oreille Rivers have covered hundreds of hectares of productive lowland vegetation. However, because the Murphy Creek reservoir would have a relatively low head and because the reservoir area is already relatively highly developed and disturbed by settlement patterns and other land uses, the impacts of the project, from a vegetation perspective, are not considered to be a major environmental concern.

MITIGATION OPPORTUNITIES

Measures available to reduce, or mitigate potential impacts on vegetation due to dam construction and reservoir clearing are limited because most of the major impacts on the vegetation resource base are considered permanent. However, the following recommendations may be useful in reducing impacts, in that they will aid in the stabilization of the soil and will probably protect lowland sites, and reduce the time required for the re-establishment of a self-sustaining vegetative cover.

* Care should be exercised in clearing the reservoir area. Clearing should be confined within the zone of inundation as much as possible, and existing access roads should be used whenever possible to facilitate movement of crews in and out of the area. Cutting of new cat trails and roads through vegetation types above the reservoir should be avoided where possible.

* A reclamation plan should be prepared prior to the clearing program, so that site preparation, resloping, and revegetation can be completed soon after any disturbance has taken place in areas that will not be inundated. A complete reclamation program of all borrow-pits, road cuts, and other major disturbances should be initiated as soon after clearing as is practical. This program should also address the drawdown zone of the reservoir and potential dust problems. Data regarding seed mixtures, suitable shrub and tree species, fertilizer requirements and other aspects related to revegetation should be gathered early in the planning process. All reclamation plans should be discussed and reviewed by the appropriate government agencies.

* Slash and debris should be removed from the reservoir area. If slash burning is to be conducted care should be exercised to avoid piling and burning slash near adjacent standing vegetation. The burning of slash is regulated by the B.C. Ministry of Forests. Chipping of small (<25 cm diameter) slash may be considered as an alternative to burning. Chips from this process may be used as a surface dressing for revegetation.

APPENDIX A

TERMS OF REFERENCE

SECTION F

VEGETATION

(a) Inventory

Prepare a set of vegetation maps at a scale of 1:25 000 (4 cm = 1 km) to describe the vegetation within the study area expanded to the 800 m contour from the outskirts of the city of Trail to Brilliant G.S., the Keenleyside Dam, and 8 km up Pass Creek, and provide data for studies on wildlife habitats and populations. Show on the map sheets, the areas of each type, and provide a detailed summary of areas of types above and below the reservoir level.

To simplify locational interpretation, depict on these maps the following physical features: roads, trails, rivers, creeks and contours.

Describe vegetation in terms of existing and climax communities. Classify the vegetation into a series of types to be based on vegetation structure and species criteria using a classification similar to that used in the Ecological Classification of the Nelson Forest District by the B.C. Forest Service. The final classification developed must meet the needs of the wildlife consultants.

As far as possible, maps should be compiled from existing aerial photographs and B.C. forest cover maps, supported by limited ground truthing. (The Forest Service Range Branch may have mapped native plant communities in some areas. Also, Resource Analysis Branch has already mapped the area for vegetation.)

Identify any special or unusual vegetational species, vegetation ecological communities, ecological reserve areas or applications within the study area.

(b) Effect of Development

Co-operate with consultants in their assessment of potential losses as a result of flooding as follows:

Wildlife - habitat losses
Forestry - forest losses
Agriclture - agricultural losses
Socio-economic - land use losses

Assess the need or possibility of preserving any special or unusual vegetation types or ecological communities.

APPENDIX B

SITE DESCRIPTIONS

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) Wayne G. Biggs
Jace Standish

PLOT/SITE NO: 01

LOCATION: Lower slope el. approx. 480m, south side of Columbia River, near Hugh Keenleyside Dam site

GENERAL VEG. DESCRIPTION: 45° - N. facing slope
Closed canopy mixed-wood forest

Soils: coarse colluvium-boulders, & litter

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	West. Larch	(20-25m)	3	
	White Birch	(10m)	2	steep, dense woodland
	Douglas-Fir	(12m)	1	
	West. Red Cedar	(15m)	1	Limited wildlife use except at edge and small clearings.
S	White Birch	(1-2m)	1	
	Thimbleberry	(1m)	2	
	Spreading Dogbane	(.5m)	2	
	W. Red Cedar	(1-2m)	1	
	Mahonia	(.75m)	1	
	Waxberry	(1m)	+	
	Rose	(1m)	+	
H	Rattlesnake Plantain		+	
	Prince's Pine		+	
	Fireweed		r	
	Wintergreen		+	
M	Polytricum juniperinum		2	
	Dicranum		1	

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) Wayne Biggs
Jace Standish

PLOT/SITE NO: 02

LOCATION: Lower slope north side of Columbia River el. approx. 550m.

GENERAL VEG. DESCRIPTION: 35°, south facing slope closed canopy conif. dominant forest

soils: eroded sandy terrace

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Douglas-Fir	(25m)	3	
	Ponderosa Pine	(25m)	2	
	West. Larch	(20m)	1	
	W. Red Cedar	(20m)	1	
	White Birch	(6-15m)	+	
S	R.S. Ceanothus	(1m)	3	- Deer tracks & some browse sign on ceanothus
	False Box	(1m)	1	
	Mahonia	(.2m)	2	
	Waxberry	(1m)	+	- appears to be suitable winter range
	Clematis	(.5-2m)	+	
	Douglas-Fir	(.5m)	r	
	Rose	(.75m)	+	
H	Aster		1	- Swainsons thrush calling.
	Pinegrass		2	
	Twisted Stalk		+	- Red Squirrel in Doug.-Fir.
	S.F. Solomon's Seal		r	
	Bearberry		+	
M	Pleurozum		+	

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 03

LOCATION: Lower slope, north side of Columbia River, 500m elevation, near gravel pit access road.

GENERAL VEG. DESCRIPTION: 30-35° slope (south facing) closed canopy mixed-wood

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Douglas-Fir	(20m)	2	
	West. Larch	(20m)	2	
	Ponderosa Pine	(20m)	1	
	White Birch	(20m)	1	
	West. Red Cedar	(20m)	+	Deer browse sign on Saskatoon and Ceanothus along pit access road-site
S	Ocean Spray	(2m)	2	
	False Box	(.2m)	2	
	Saskatoon	(1m)	1	
	Blueberry	(.75m)	+	
	Mahonia	(.2m)	1	
	Douglas-Fir	(1m)	+	
	Aspen	(2m)	r	
H	Aster		+	
	Domestic Grasses		2	
	Clover		r	
	Queen's Cup		+	
M	Very limited.			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) W. Biggs
J. Standish

PLOT/SITE NO: 04

LOCATION: North side of Columbia River, off gravel pit access road el. approx. 500-520m.

GENERAL VEG. DESCRIPTION: Open canopy forest on south facing slopes, rocky bluffs

Soils: rocky outcrops, thin soils

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Ponderosa Pine	(25m)	1	
	Lodgepole Pine	(20m)	+	
	Douglas-Fir	(15m)	r	
				- Coyote scat
				- Bear scat (filled with Saskatoon berries)
S	Saskatoon	(1m)	1	
	Mahonia	(.2m)	+	- Deer browse on Saskatoon
	Sp. Dogbane	(.75m)	+	
	Rose	(1m)	r	- Fairly high w/l use, good food resources and nearby cover habitat
H	Pinegrass		3	
	(Bare rock)		(3)	
	Lupine		+	
	Yarrow		r	
M	Limited mosses occ. Cladinia Lichen and Lichens on rock			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 05

LOCATION: Lower slope above Pass Creek road near Raspberry

GENERAL VEG. DESCRIPTION: Shrub dominant hillside, seral community after 1967 forest fire (small groves of trees present)

Soils: sandy colluvium, some large boulders

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Aspen	(10m)	r(clone)	
	White Birch	(12m)	r-t(in wet draws)	
	Lodgepole Pine	(3m)	r	
	P. Pine (vets)	(10m)	+	
S	Hazelnut	(1-2m)	3	
	R.S. Ceanothus	(1m)	2	
	Waxberry	(1m)	2	
	Rose	(1m)	+	- American Goodfinch feeding on grass seeds
	Red Elderberry	(2m)	+	
	Saskatoon	(1-2m)	+	- Probably other passerine species nesting in Hazelnut and taller shrubs
	Sp. Dogbane	(.5m)	+	
	Ocean Spray	(1m)	+	
H	Bracken Fern		2	
	Grasses		1	
	Lupine		1	
	Purple Vetch		+	
M	Few			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 06
LOCATION: Pass Creek Valley

GENERAL VEG. DESCRIPTION: Dry closed canopy pine forest, level area of sandy soil, probably fire successional

Soils: sandy with occ. rocks (.5m diameter)

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Lodgepole Pine	(20m)	3	
S	False Box	(5.1m)	1	- no particular wildlife impact
	Spreading Juniper	(2m)	1	
	Lodgepole Pine	(2-5m)	2	- likely a fire successional community. Not extensive but representative of Lodgepole Pine stands further up the Pass Creek Valley
	Saskatoon	(1m)	+	
	Mahonia	(.5m)	+	
	Sp. Dogbane	(.5m)	+	
H	Bearberry		1	- Relatively low species diversity.
	Pinegrass		1	
	Heart Leaf Arnica		+	
	Blueberry		r	
M	Unidentified mosses		2	

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 2, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 07

LOCATION: Approx. 2.5m above creek level at Pass Creek Regional Park, north end of hiking trail.

GENERAL VEG. DESCRIPTION: Largely deciduous dominant lowland (mixed-wood) plant community, high diversity (probably not affected by nearby '67 burn)

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	White Birch	(20-25m)	2	
	Douglas-Fir	(20-25m)	2	
	White Pine	(20-25m)	+	
	W. Red Cedar	(25m)	+	
	Hemlock	(20m)	+	
	Grand Fir	(20m)	+	
S				- Community dark & overgrown
	Yew	(5m)	1	
	Maple	(2m)	+	- Riparian
	R.S. Ceanothus	(1m)	+	- Areas along Pass Creek banks probably used by deer and other wildlife species.
	Hazelnut	(1m)	r	
	Rose	(1m)	+	
	Willow(at creek side)	(3m)	+	
	B. Cottonwood (near Pass Creek)	(1-3m)	+ to 1	
H	Star-flowered Solomon's Seal		+	
	Rattlesnake Plantain		+	- Flicker nesting on cottonwood along creek.
	Sarsaparilla		+	
	Twisted Stalk		+	
	Queens Cup		+	
M	Polythricum juniperinum		+ to 1	
	Hypnum		+	

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 3, 1980
SURVEYOR(S) Wayne Biggs
Jace Standish

PLOT/SITE NO: 08

LOCATION: East facing hillside (slope 20-45%). Above water tank west of Castlegar. (Directly across Columbia River from Selkirk College)

GENERAL VEG. DESCRIPTION: Deciduous dominant seral community (mixed-wood)
Soils: loamy sand, 10% coarse fragments

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	White Birch	(20m)	2	
	Prunus Sp.	(10m)	+	
	Douglas-Fir	(10-15m)	+	
	Ponderosa Pine	(15m)	+	- occ. plum (possib. cherry) trees and apple trees established in the area.
S	Hazelnut	(2m)	2	
	Willow	(2-5m)	1	Probably "escaped" (birds) from neighboring, aband. Doukhabor farm.
	Douglas-Fir	(2m)	+	
	Mahonia	(.2m)	+	
	Ceanothus	(1m)	3(in clearing)	
	Rose	(1m)	+	
	Waxberry	(1.5m)	r	
	Maple	(1-2m)	+	
H	Hooker's Fairy Bells		+	
	Bracken Fern		1	
	Pinegrass		+	
	Aster		+	
	Butter & Eggs		r	
M	Limited Bryophyte cover			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025

DATE. July 3, 1980

SURVEYOR(S) Wayne Biggs
Jace Standish

PLOT/SITE NO: 09

LOCATION: Approx. 2km west of High Arrow Hotel, Castlegar. Near natural gas transmission line clearing el. approx. 550-600m.

GENERAL VEG. DESCRIPTION: Mixed wood forest-closed canopy slope 50%, east facing slope

Soils: sand -(variable to) loamy sand

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	W. Birch	(20m)	2	- steep hillside
	W. Larch	(20m)	2	
	Douglas-Fir	(15-20m)	2	- appears to be succeeding to RW cedar and Douglas-fir dominant climax. Age of larger fir trees 65 yrs.
	White Pine	(15-20m)	1	
	W. Red Cedar	(20m)	+	
S	Lodgepole Pine	(15-20m)	+	
	Birch(in openings)	(2-5m)	1	
	Pacific Yew	(2m)	+	
	Thimbleberry	(1-2m)	+	
	Bracken(at edge)	(1m)	+	
	W.R. Cedar	(2m)	+	
	False Box	(.5m)	+	
	Mahonia	(.2m)	+	- soils stabilized by accumulation of litter and humus.
H	Hooker's Fairy Bells		+	
	Sarsaparilla		1	
	Rattlesnake Plantain		r	
	Queen's Cup		+	
	Twinflower		r	
M	Mosses occur only on rotting wood			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 4, 1980
SURVEYOR(S) W. Biggs
J. Standish

PLOT/SITE NO: 10

LOCATION: 1km north of Industrial Park Development site (near Highland Meadows Subdivision - Kinnaird)

GENERAL VEG. DESCRIPTION: Mature closed canopy mixed wood forest level - 20% slope

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	White Birch	(15m)	3	
	White Pine	(15m)	2	
	W. Red Cedar	(15m)	2	
	W. Hemlock	(15m)	+	- Plot/site nearly level, but area generally sloping toward a creek.
	Ponderosa Pine	(15m)	+	
S	False Box	(5m)	2-3	
	Maple	(2m)	+	
	Blue Clematis	(2m)	+	Black cottonwood mock orange & willow occur on lowland sites
	Birch	(2m)	+	
	Hemlock	(1m)	r	
H	Bracken Fern	(1m)	1	
	Hooker's Fairy Bells		+	- Black locust occur along roadways in nearby Highland Meadows Subdivision
	Queen's Cup		1	
	Twinflower		+	
	Prince's Pine		r	
	Sarsaparilla		+	
M				
	Rhytidelphus sp.		+	(Ht. approx.6m)
	Unidentified mosses on rotting wood			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 3, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 11

LOCATION: North side of Blueberry Creek on alluvial fan near confluence with Columbia River

GENERAL VEG. DESCRIPTION: Mixed-wood forest (Mesic site) el. approx. 430m Blueberry Creek alluvial fan

Soils: variable - sand coarse cobbles

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*
T	Black cottonwood	(15m)	3
	Douglas-Fir	(12m)	2
	Lodgepole Pine	(10m)	1
	Ponderosa Pine	(10-15m)	+(1-on drier sites)
	White Pine	(12-15m)	+
S	Hazelnut	(1m)	1
	Saskatoon	(2m)	+
	Maple	(2m)	r
	Mock orange	(1.5m)	2(along creek)
	Willow	(2m)	1
	Thimbleberry	(1m)	1
	Blueberry	(.75m)	+
	Sp. Dogbane	(.5m)	+
H	Bluebell		1
	Columbia Lily		r
	Bearberry		3 (on dry sites)
	Queen's Cup		+
	Sarsaparilla		+
M	Limited Bryophyte flora		

NOTES:

- heavy browse on Saskatoon & willow
- increment boring of five trees & other prod. measurements taken

Tree 1. W.White Pine
Age. 61 years
DBH 27.2 cm
Ht. 12m

Tree 2. W. Pine
Age 51 years
DBH 36.1 cm
Ht. 12m

Tree 3. Douglas-Fir
Age 57 years
DBH 28.6 cm
Ht. 12m

Tree 4. Douglas-Fir
Age 40 years
DBH 24.3 cm
Ht. 10m

Tree 5. Pond. Pine
Age 31 years
DBH 25.0 cm
Ht. 10m to 15m

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 3, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 12

LOCATION: East facing slope about 20%. West of Blueberry Creek. el. approx. 500-600m.

GENERAL VEG. DESCRIPTION: Second growth, mixed-wood forest-closed canopy (Seral stand of Birch & Aspen even age approx. 20 years)
Soils: sandy with some coarse gravel

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	White Birch	(14-18m)	2	
	Aspen	(10m)	3	* Douglas-Fir seedlings & occ. pine seedlings established.
	Douglas-Fir	(10m)	+	
S	Falsebox	(.2m)	1	
	Bracken	(1m)	3	
	R.S. Ceanothus	(1m)	+	- Likely will succeed to D-Fir dominant mixed wood
	Dogbane	(.2m)	+	
	Mahonia	(.5m)	+	
	Larch	(1m)	r	
	Hazelnut	(2m)	+ to 1	
H	Bearberry		1	- Browse sign on Ceanothus
	Queen's Cup		+	
	Strawberry		+	
	Pine Grass		2 (patchy distrib.)	
M	Very limited on sandy soils			

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 4, 1980
SURVEYOR(S) W.G. Biggs
J. Standish

PLOT/SITE NO: 13

LOCATION: Near highway Bridge crossing of Murphy Creek. Abandored Highway.

GENERAL VEG. DESCRIPTION: Simple community of black locust trees overstory and grass groundcover

Soils: coarse bouldery, rocky soils.

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Black Locust (Trees with ripe seed capsules)	(10-12m)	3	- Increment of Black Locust 25 yrs. old DBH 12.7 cm 10m high
S	Black Locust	(1-5m)	1	- robin nesting in Black Locust
H	Grass (Unident; grasses probably introduced along old highway-agronomic species)		4	- heavy seed set; possible wildlife value of seeds (rodents, birds)
M	None			- appears as if B. Locust excludes other species from invading

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 4, 1980
SURVEYOR(S) W. Biggs
J. Standish

PLOT/SITE NO: 14

LOCATION: Lowland below Selkirk College Road near Highway crossing & Airport.

GENERAL VEG. DESCRIPTION: Hillside leading down to Columbia River el. approx. 430m-450m. (10% slopes N. facing) mixed wood closed canopy forest.

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Lodgepole Pine	(15m)	2	
	W. Birch	(15m)	2	- osprey with fish in talons observed flying north along Columbia River
	R. Cedar	(15m)	+	
	W. Pine	(12m)	+	
	Rocky Mt. Juniper	(2m)	+	
	Douglas-Fir	(12m)	+	
S				
	Bracken	(1m)	2	- Saskatoon in clearing well-used as browse by deer
	Hazelnut	(1.5m)	1	
	Blueberry	(.75m)	+	
	Sp. Dogbane	(.5m)		
	R.S. Ceanothus	(1m)		- numerous songbirds diverse habitat
	Saskatoon	(1m)	+ to 1 (patchy)	
	Knapweed	(.5m)	+ to 2 (in clearings)	
H	Purple Vetch		+	- Hawthorne occurs but all trees are dead, insect damage
	Unident. grasses		1	
	Queen's Cup		+	
	Archostaphylos		+ to 3 (on gravel near river)	
	Sarsaparilla		1	- appears as if juniper has invaded rocky river bank since water levels in river have become regulated by Hugh Keenleyside and/or Brilliant Dam.
	Bluebell		+	
M				

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

TALISMAN Land Resource Consultants

VEGETATION FIELD DESCRIPTION SHEET

TALISMAN PROJECT NO. 80-025
DATE. July 4, 1980
SURVEYOR(S) W. Biggs
J. Standish

PLOT/SITE NO: 15

LOCATION: Lowlands S. side Champion Creek. Fan at confluence. El. approx. 425-430m.

GENERAL VEG. DESCRIPTION: Closed canopy deciduous dominant mixed woods dense understory in places but variable according to drainage and micro relief.
Soils: alluvial sands - silts

	SPECIES PRESENT:	HT(EST)	COVER/ABUNDANCE*	NOTES:
T	Black cottonwood	(20-30m)	3	
	Lodgepole Pine	(20m)	1	
	W. Red Cedar	(20m)	1	
	W. Birch	(10-12m)	+	- Spotted sandpiper feeding along bank of Champion Creek.
S	Hawthorne	(3m)	+	
	Saskatoon	(1m)	+	
	R. Osier Dogwood	(1m)	+	- Skink found beneath cobbles in aband. creek bed.
	R.S. Ceanothus	(1m)	+	
	Waxberry	(.5m)	+	
	Willow	(1-2m)	+ to 1	
	Mock orange	(1m)	+	- diverse shrub cove mock orange and willow occurring on alluvial silt
	Hazelnut	(1-1.5m)	+	
H	Poison ivy		+	
	Grasses		+	- red osier dog-wood, ceanothus and hazelnut on slightly denser sites
	Horsetail		+ to 1(in wet areas)	
	Bluebell		+	
	Strawberry		+	
	Forget-me-not		+	
M	None recorded			- willow trees (ca. 8m) along creek bed

* Braun-Blanquet Scale: 5, >75%. 4, 50-75%. 3, 25-50%. 2, 5-25%. 1, 5%. + small. r, sol.

APPENDIX C

LIST OF PLANT SPECIES

LIST OF PLANT SPECIES

Common Name	Scientific Name
Trees	
bitter cherry	*Prunus emarginata* (Dougl.) Walp.
black cottonwood	*Populus balsamifera* L. ssp. *trichocarpa* (Torrey & Gray) Brayshaw
black hawthorn	*Crataegus douglasii* Lindl.
black locust	*Robinia pseudoacacia* L.
cascara	*Rhamnus purshiana* DC.
Douglas-fir	*Pseudotsuga menziesii* (Mirbel) Franco var. *glauca* (Beissn.) Franco
Douglas maple	*Acer glabrum* Torr.
Engelmann spruce	*Picea engelmannii* Parry
grand fir	*Abies grandis* (Dougl.) Forbes
hazelnut	*Corylus cornuta* Marsh.
lodgepole pine	*Pinus contorta* Dougl. var. *latifolia* Engelm.
Lombardy poplar	*Populus nigra* L. var *italica* Duroi
mountain alder	*Alnus tenufolia* Nutt.
ponderosa pine	*Pinus ponderosa* Laws.
Rocky Mountain juniper	*Juniperus scopularum* Sarg.
subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
trembling aspen	*Populus tremuloides* Michaux
western hemlock	*Tsuga heterophylla* (Raf.) Sarg.
western larch	*Larix occidentalis* Nutt.
western red cedar	*Thuja plicata* Donn
western white pine	*Pinus monticola* Dougl.

Common Name	Scientific Name
western yew	Taxus brevifolia Nutt.
whitebark pine	Pinus albicaulis Engelm.
white birch	Betula papyrifera Marsh.
willow	Salix spp.
Shrubs	
black blueberry	Vaccinium membranaceum Dougl.
blue clematis	Clematis columbiana T. & G.
Canada buffalo berry	Shepherdia canadensis (L.) Nutt.
devil's club	Oplopanax horridus (Smith) Miq.
honeysuckle	Lonicera ciliosa (Pursh) DC.
Hudson Bay currant	Ribes hudsonianum Richards.
mallow ninebark	Physocarpus malvaceus (Greene) Kuntz
mock orange	Philadelphus lewisii Pursh
oak fern	Gymnocarpium dryopteris (L.) Newm.
ocean spray	Holodicus discolor (Pursh) Maxim.
prickly rose	Rosa acicularis Lindl.
red elderberry	Sambucus racemosa L.
red osier dogwood	Cornus stolonifera Michx.
redstem ceanothus	Ceanothus sanguineus Pursh
Saskatoon berry	Amelanchier alnifolia Nutt.
spreading dogbane	Apocynum androsaemifolium L.
thimbleberry	Rubus parviflorus Nutt.
waxberry	Symphoricarpus albus (L.) Blake
Herbs and Low Woody Shrubs	
bearberry	Arctostaphylos uva-ursi (L.) Spreng.

Common Name	Scientific Name
birch-leaf spirea	Spirea betulifolia Pall.
bluebell	Campanula rotundifolia L.
bluebunch wheatgrass	Agropyrum spicatum (Pursh) Scribn. & Smith
bracken fern	Pteridium aquilinum (L.) Kuhn.
butter and eggs	Linaria vulgaris Hill
butter cup	Ranunculus spp.
cattail	Typha latifolia L.
creeping mahonia	Mahonia repens Lindl.
false box	Pachistima myrsinites (Pursh) Raf.
false Solomon's seal	Smilacina racemosa (L.) Desf.
fireweed	Epilobium angustifolium L.
forget-me-not	Myosotis sylvatica Hoffm.
great mullein	Verbascum thapsus L.
grouseberry	Vaccinium scoparium Leiberg
heart-leaved arnica	Arnica cordifolia Hook.
Hooker's fairy bells	Disporum hookeri (Torr.) Nicholson
horsetail	Equisetum arvense L.
indian pipe	Monotropa uniflora L.
knapweed	Centaurea spp.
lupine	Lupinus spp.
mahonia	Mahonia aquifolium (Pursh) Nutt.
nodding onion	Allium cernuum Roth
northern bedstraw	Galium boreale L.
pinegrass	Calamagrostis rubescens Buckl.
poison ivy	Rhus radicans L.
prince's pine	Chimaphila umbellata (L.) Bart.

Common Name	Scientific Name
purple aster	Aster conspicuus Lindl.
purple vetch	Vicia spp.
queen's cup	Clintonia uniflora (Shult.) Kunth
rattlesnake plantain	Goodyera oblongifolia Raf.
rushes	Juncus spp.
sarsaparilla	Aralia nudicaulis L.
sedge	Carex spp.
skunk cabbage	Lysichitum americanum Hulten & St. John
star-flowered Solomon's seal	Smilacina stellata (L.) Desf.
stonecrop	Sedum spp.
strawberry	Fragaria virginiana Duchesne
strawberry blite	Chenopodium capitatum (L.) Aschers.
thistle	Cirsium spp.
twinflower	Linnaea borealis L.
twisted stalk	Streptopus amplexifolius (L.) DC.
western teaberry	Gaultheria ovatifolia Gray
western fescue	Festuca occidentalis Hook.
wintergreen	Pyrola asarifolia Michx.
yarrow	Achillea millefolium L.

Mosses and Lichens

Cladina sp. (lichen)

Mnium sp. (moss)

Peltigera sp. (lichen)

Pleurozium schreberi (Brid.) Mitt. (moss)

APPENDIX D

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POOR

QUALITY

ORIGINAL